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U.S. Department
of Transportation
**Federal Aviation
Administration**

Federal Aviation Regulations

Part 27
Airworthiness Standards: Normal Category Rotorcraft

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Published
August 1974

Consolidated Reprint
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reprint incorporates:
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as of 6/13/86

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PART 27

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Introductory Note

Part 27 is codified under Subchapter C, Aircraft, of Title 14 of the CODE OF FEDERAL REGULATIONS.

This FAA publication of the basic Part 27, effective February 1, 1965, incorporates Amendments 27-1 through 27-8 and any changes required by the Department of Transportation transition amendment.

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Adoption of Part 27

Adopted: October 2, 1964 **Effective: February 1, 1965**

(Published in 29 F.R. 15694, November 24, 1964)

This amendment adds Part 27 [New] to the Federal Aviation Regulations to replace Part 6 of the Civil Air Regulations, and is a part of the Agency recodification program announced in Draft Release 61-25, published in the Federal Register on November 15, 1961 (26 F.R. 10698).

Part 27 [New] was published as a notice of proposed rule making in the Federal Register on May 23, 1964 (29 F.R. 6822), and given further distribution as Notice No. 64-29.

During the life of the recodification project, Chapter I of Title 14 may contain more than one part bearing the same number. To differentiate between the two, the recodified parts, such as this one, are labeled "[New]". The label will be dropped at the completion of the project as all of the regulations will be new.

Many of the comments received recommended specific substantive changes to the regulations. Many of these recommendations appear to be meritorious. However, they cannot be adopted as a part of the recodification program, since the purpose of the program is simply to streamline and clarify present regulatory language and delete obsolete or redundant provisions. To attempt substantive changes, other than relaxatory ones that are completely noncontroversial, would delay the project and be contrary to the ground rules specified for it in Draft Release 61-25. However, all comments of this nature will be preserved and considered in any later substantive revision of this part.

Present CAR Part 6 reflects the various writing styles used by those who have worked on it in the past. Consistency in language is vital to consistency in interpretation and fairness in application, especially in technical, complex rules such as this one. The recodification has allowed us to use one style throughout Part 27 [New]. The style changes that have been made do not affect substance.

Part 27 [New] substitutes the word "must" for "shall". This has been done because airworthiness standards are conditions precedent that must be met for the issue of a type certificate. The imperative "shall" would be inappropriate since the failure to meet these standards simply results in a denial of the certificate without further penalty.

The sections in Part 27 [New] have been rearranged and renumbered so that the requirements of this part have the same number as comparable requirements in Parts 23 [New], 25 [New], and 29 [New]. This explains apparent gaps in section numbers in this part, such as that between § 27.79 Limiting height-speed envelope and § 27.141 General. (This gap, for instance, is assigned to the turbine engine performance requirements of Part 25 [New], and includes the normal "growth" gap between subtopics.) Comparative review of specific requirements between airworthiness parts is greatly facilitated by this rearrangement, and has already resulted, for example, in the deletion of §§ 6.202(c), 6.340, 6.380, 6.480, 6.600, 6.602, 6.610, 6.700(a), and 6.744 as surplusage, and in the significant simplification of the Rotorcraft Flight Manual requirements in § 27.1581. Further, this rearrangement allows more efficient review of all parts in the light of comments received on any single part. For example, a comment received on Part 23 [New] has resulted in the deletion of all but the last sentence of the requirement that now appears in § 27.607. As industry becomes acquainted with the new format, the effectiveness of comments received should be greatly magnified.

As was stated in the preamble of the notice of proposed rule making of Part 27, those definitions in present Part 6 (and not now in Part 1 or executed in this part) that are necessary will be recodified with the definitions in other airworthiness parts and added to Part 1 [New]. The detailed disposition of § 6.1 in the distribution table should resolve most definition problems that may arise.

The definitions, abbreviations, and rules of construction in Part 1 [New] of the Federal Aviation Regulations apply to Part 27 [New].

The most significant changes to Part 27 since the notice are listed below. The numbers in parentheses refer to the section numbers in the notice and in former Part 6, respectively.

(1) In § 27.25 (27.23) (6.101), paragraph (a)(2)(iv), the phrase "an occupant weight of" has been added between "seat," and "170 pounds". This was done to make it clear that the weight of the seat itself need not be included in the determination of the subject weight.

(2) In § 27.143 (27.65) (6.121), paragraph (b), subparagraph (2) has been deleted from the section as it appeared in the notice. This effectuates the second paragraph of the preamble in CAR amendment 6-4, effective October 1, 1959, in which it was intended that § 6.121 be revised to replace the requirement for a demonstration of controllability after power failure at only one high speed condition, namely § 6.121(c), with a requirement for controllability after power failure over the range of airspeeds and altitudes for which certification is sought, namely § 6.121(e). Insofar as the intended deletion was not made in the rule at that time and both requirements remained outstanding, the deletion of § 6.121(c) at this time is relaxatory.

(3) The Aerospace Industries Association, Inc. (AIA) suggested that the word "maximum" between "A" and "wind velocity" in § 27.143 (27.65) (6.121) was ambiguous, since in context it could refer either to a performance maximum or to the "maximum" safe wind for operation near the ground in § 27.1587 (27.789) (6.743). Since ultimate performance capability need not be shown under § 27.143, the word "maximum" has been deleted.

(4) In §§ 27.547 and 27.361 (§§ 27.217 (e) and 27.219(e)) (6.250 and 6.251), the word "design" has been deleted since all prescribed loads are design loads.

(5) In § 27.241 (27.31) (6.131), the word "uncontrollable", between "no" and "tendency" has been replaced with the word "dangerous". This was done to harmonize the language with the actual standard against which ground resonance must be judged.

(6) In § 27.301 (27.121) (6.200), the descriptions of limit and ultimate loads have been put back in. It is felt that their utility will be greater in the basic rule than in Part 1 [New].

(7) In § 27.601 (27.251) (6.300), the reference to experience as an element in determining which "hazardous or unreliable" features are covered by the rule has been put back in. This change was made at the request of AIA and is clarifying only.

(8) In § 27.611 (27.261) (6.305), paragraph (a), "periodic inspection" has been replaced with "recurring inspection". This avoids any potential conflict between the intent in the subject section to cover all inspections that occur at regular intervals and the more specific use of the term "periodic inspection" in Parts 43 [New] and 91 [New].

(9) AIA suggested that the language in § 27.775 (27.355) (6.352) be revised to make it clear that (1) materials other than glass may be used in the windows and (2) only glass panes need contain nonsplintering safety glass. This has been done.

(10) Because of an AIA comment to § 27.807 (27.365(a)) (6.357), paragraph (a), the phrase "as prescribed by the Administrator", between "provided" and "where", has been deleted since all requirements in this part are prescribed by the Administrator.

(11) Aero Flow Dynamics, Inc., suggested that the heading and language in § 27.997 (27.471) (6.427) be conformed to that in other airworthiness parts. This has been done.

(12) Section 27.1309 (27.587) (6.606) has been revised to make it clear, as in the original rule, that the general requirement of guarding against hazard in the event of malfunctioning or failure applies to all equipment, systems, and installations, not only to those whose functioning is necessary to show compliance with any regulations in this subchapter.

(13) At the suggestion of AIA, § 27.1505 (27.733(b)) (6.711), paragraph

(b), has been reworded to clarify the permissive aspect of this section.

Other minor changes of a technical clarifying nature have been made. They are not substantive and do not impose any burden on regulated persons.

In the notice, it was proposed to convert references to "miles" and "miles per hour" to their exact nautical equivalents. Many formulae have been derived under the existing system. The effect of rounding off to the nearest whole number is unclear in certain cases. Although specifically invited, few comments have been received on this problem. Because of this it is felt that wholesale conversion should be made separately at a later date.

Interested persons have been given an opportunity to participate in the making of this regulation and due consideration has been given to all relevant matter presented. The Agency is appreciative of the cooperative spirit in which the public's comments were submitted.

In consideration of the foregoing, Chapter I of Title 14 of the Code of Federal Regulations is amended as follows, effective February 1, 1964.

1. By deleting Part 6.

2. By adding a Part 27 [New] reading as hereinafter set forth.

AUTHORITY: The provisions of this Part 27 issued under secs. 313(a), 601, 603, Federal Aviation Act of 1958; 49 U.S.C. 1354(a), 1421, 1423.

Amendment 27-1

Miscellaneous Aircraft Propulsion System Design Requirements

Adopted: April 28, 1967 **Effective: June 4, 1967**

(Published in 32 F.R. 6908, May 5, 1967)

This amendment adds miscellaneous changes to the propulsion system design requirements for airplanes and rotorcraft. This amendment is based on, and reflects public comments concerning, notice of proposed rule making 65-43, published in the FEDERAL REGISTER (31 F.R. 93) on January 5, 1966. Except as modified by the following discussion, the reasons for this amendment are those in the notice. Changes to the proposals in the notice, and disposition of public comments, are as follows:

The amendments to the combustion heater fire protection requirements of §§ 23.859, 25.859, 27.859, and 29.859 are drafted as proposed. One comment objected to the proposals for the following reasons: (1) The commentator states that this amendment would cause unnecessary expense and increase system complexity with a resultant reduction in reliability. The Administrator disagrees. This amendment merely clarifies the rules to reflect longstanding administration of the rules to require the appropriate shutoff device when any of the listed conditions occurs. Combustion heaters have been meeting this requirement for many years without evidence of unnecessary complexity or reduced reliability related to the requirement. This amendment makes no substantive change to this practice; (2) the commentator states that the words "and hold off" are present in Parts 23 and 27 but not in Parts 25 and 29, which indicates that an unnecessary burden may be involved in the case of nontransport category aircraft and should be deleted from Parts 23 and 27. The words "and hold off" are in the present rule. This amendment was intended to effect no substantive change. This comment therefore goes beyond the legitimate scope of the notice. However, the Administrator agrees that this comment may have merit. The comment will therefore be retained for possible rule-making action; (3) the commentator states that the rule should be clarified to allow the pilot to reenergize the heater after it has been shut off in flight, and to allow the use of one safety device to meet the rule with respect to all of the listed conditions requiring shutoff. The Administrator disagrees. This amendment, as written, does not prohibit re-energizing the heater during flight, nor does it prohibit the use of a single device that otherwise complies.

Another comment stated that long operating experience with combustion heaters does not indicate a need for "this sophisticated system." As stated above, no change in practice would result from this clarifying amendment. No change in required degree of sophistication is intended. The cited long operating experience was in fact obtained with systems which meet the rule as currently administered and as reflected in this amendment.

Proposed new §§ 23.906, 25.906, 27.906, and 29.906 are withdrawn. These proposed sections would have required the applicant for an aircraft type certificate to obtain, from the engine and propeller manufacturer, all vibration information that those manufacturers can supply to show compliance with the vibration requirements for aircraft. One industry comment stated that the proposed rule is unnecessary since § 21.21(b) requires, for an aircraft, that no feature or characteristic make it unsafe for the category in which certification is requested. Another industry comment stated that the proposal is not stringent enough. The FAA will continue in the future, as it has in the past, to administer § 21.21 (b) to require the use of engine and propeller vibration data to account for vibration conditions that result from the combination of specific engines, propellers, and airframes, where such investigation is necessary for safety. It is believed, however, that the possible kinds and sources of adequate vibration data are too numerous to be adequately covered in a specific, enforceable standard at this time.

The proposed change to § 23.907, deleting the reference to the propeller manufacturer, was based on proposed new § 23.906 which would have made that reference redundant. Since proposed § 23.906 is withdrawn, the proposed change to § 23.907 is not appropriate and is also withdrawn.

The notice proposed to amend § 25.933 to require that each turbojet reversing system must have means to prevent the engine from producing more than "idle forward thrust" when the reversing controls are set for reverse but the reversing system is not in the reverse position. Two comments stated that the limitation to "idle forward thrust" would impede reverser design unnecessarily and suggested that maintenance of directional control during reverser malfunction should be the only test for compliance. The administrator agrees that safety does not require a limitation to any specific thrust value if directional control can in fact be maintained. The approach recommended by industry is therefore allowed, by exception, in this amendment. However, in adopting the industry approach, it must be pointed out that safety requires that directional control capabilities be investigated under the most critical conditions expected in operation. Safety also requires that such control be maintained with aerodynamic means alone, since rapid diagnosis of a reverser malfunction, and timely correction by use of thrust controls, cannot be assumed when a reverser fails at the most critical condition. Dependence, even partial dependence, on other nonaerodynamic means of control such as differential use of brakes, is also not consistent with safety under the most critical conditions in which reverser malfunction could occur. Section 25.933 is drafted to reflect these factors.

The notice proposed to amend § 25.939 to require that operation of the airplane within the portion of the flight envelope that produces the "highest negative acceleration loads" may not cause hazardous malfunction of any part of the turbine powerplant, and to require that "the vibration characteristics" of turbine engine components whose failure could be catastrophic may not be "adversely affected" during normal operation. The notice also proposed to add new §§ 27.939 and 29.939 containing the requirements of § 25.959 in effect prior to this amendment plus the same negative acceleration and vibration requirements added to § 25.939.

One comment objected to the negative acceleration requirement for the following reasons: (1) The commentator states that the requirement involves engine design and may therefore be beyond the aircraft manufacturer's control. The Administrator does not agree that responsibility for proper operation of the turbine engine powerplant within the established flight envelope can be divided between the airplane and engine manufacturers during type certification of the airplane. Further, aircraft applicants have shown themselves capable of showing compliance with special conditions requiring that powerplant operation be safely maintained at vertical accelerations of less than zero g for specified lengths of time; (2) the commentator states that the requirement could be administered to require that the airplane be flown continuously to the negative limits of the maneuvering and gust envelopes for the airplane, whereas lesser negative acceleration loads may in fact be more critical from a fuel flow standpoint. The Administrator agrees with this comment. This result is not intended. The proposal is therefore amended to refer to "the negative acceleration * * * that is most critical from a fuel flow standpoint"; (3) the commentator states that substantiation of the fuel flow provisions under negative loads is not necessary because turbine engine powered airplanes either have continuous ignition or have systems that, when operated according to instructions in the Airplane Flight Manual, will provide ignition continuously during critical phases of takeoff, landing, icing conditions and in turbulence. The Administrator disagrees. While continuous ignition operation may broaden the range of fuel flow disturbances that can be tolerated without flameout, and is therefore significant from a safety standpoint, such ignition cannot prevent a flameout that results from fuel flow stoppage such as occurs when negative acceleration allows fuel ports to become uncovered. In such a case a restart cycle may be necessary. Instructions in the Airplane Flight Manual are no substitute for substantiation of the fuel system under negative loads; (4) the commentator states that long service experience shows that turbine engine fuel system components are not sensitive to negative acceleration loads, contrary to a statement in the preamble to the notice. The Administrator agrees in part. The sensitivity of the turbine fuel system to negative loads lies not in specific components, but rather in the sensitivity of the turbine engine to fuel flow stoppage, the high flow rates in the system, and the consequent speed with which air introduced into the system can reach the engine and result in flameout; (5) the commentator states that, while it is true that extended periods of negative acceleration may result in deterioration in performance due to interrupted flow, turbine engine fuel systems have been shown to be acceptable for the shorter exposure times actually encountered. The Administrator agrees. Investigation of the safety of turbine fuel systems under representative negative acceleration loads has long been required by special condition. This amendment therefore changes the proposal by adding the words "this must be shown for the greatest duration expected for that acceleration."

The commentator objected to the proposed vibration requirement, which affects Parts 25, 27, and 29, for the following reasons: (1) The commentator states that the proposal is unnecessary in Part 25, because of general § 25.601. The Administrator agrees that § 25.601 may be administered to cover specific vibration hazards. However, the Administrator's practice is to prescribe specific standards directly where such standards are in fact determined to be necessary for safety; (2) the commentator states that the proposal is unnecessary because vibration substantiation is already being done on a cooperative basis by industry. It is appreciated that vibration substantiations are already being accomplished. It should be noted, however, that special conditions have required such substantiation for more than a decade; (3) the commentator states that the proposal is too broad and, in the case of Parts 27 and 29, should be amended to refer to allowable vibration limits established by the engine manufacturer. The Administrator agrees. This amendment therefore covers only the turbine engine air inlet system, prohibits only harmful vibration resulting from air flow distortion, and covers normal operation only. This is consistent with special conditions applied over a large number of years. However, since there is no requirement that specific vibration limits (as opposed to values actually withstood during testing of the engine) be established by the engine manufacturer, the requested reference to allowable vibration limits established by the engine manufacturer is inappropriate and is not incorporated in this amendment.

One comment stated that the vibration standards should be similar to the more detailed standards in certain British Civil Airworthiness Requirements or, in the alternative, that similar material be placed in an Advisory Circular. While these suggestions go beyond the immediate scope of this amendment, they are appreciated and will be held for future reference.

The notice proposed to amend § 25.955 to require that turbine engine fuel systems "have means to automatically" ensure the uninterrupted flow of fuel to each turbine engine when the tank supplying that engine is depleted of fuel. One comment stated that the proposal should be limited to tanks which supply the engine in normal operation, and should not be applied to tanks that can supply the engine by cross feed. The Administrator agrees. This amendment thus uses the words "any other tank, that normally supplies fuel to that engine alone, * * * " One comment objected to the proposal, stating that the probability of an almost depleted tank in a single-tank-per-engine fuel system is very low. This amendment, however, applies only where another tank that normally supplies the engine contains usable fuel, which would not be the case in a single-tank-per-engine system. Another comment recommended that this amendment make it clear that manual switching capability is required. This comment is accepted. The proposal did not intend to eliminate present practice with respect to appropriate manual switching capability. A further comment objected to the proposal for the following reasons: (1) The commentator states that to require a "means" that is "automatic" strongly implies a sophisticated device that would introduce unnecessary hazards of its own. In order to prevent such an implication, this amendment more generally requires the fuel system design to "prevent interruption * * * without attention by the flight crew." No dictation of specific design or specific degree of complexity or sophistication is intended; (2) the commentator states that adequate fuel interruption warning is provided before flameout by fuel flow and pressure fluctuations, fuel pump low pressure warning lights, loss of rotor speed, reduction in EPR, and by fuel pressure and quantity instruments required by § 25.1305 (f) and (i) The Administrator disagrees. Considering the hazards of flameout outlined in the notice, experience has not shown that the monitoring of powerplant instruments provides a safe alternative to ensuring uninterrupted fuel flow without attention by the flight crew.

One comment objected to the proposal for the following reasons: (1) The commentator states that, to its knowledge, there has not been a problem with flameout caused by fuel interruption that indicates a need for automatic tank switching. Experience indicates that the hazard of flameout in a turbine fuel system is severe enough to warrant requiring, as a minimum standard, that some design feature (not necessarily "switching" that is "automatic") be incorporated to ensure uninterrupted fuel flow without attention by the flight crew; (2) the commentator states that an automatic switching device would result in a relaxation of fuel monitoring due to reliance on the device. It is likely that overall fuel management would suffer. Further, monitoring of the fuel in the nearly depleted condition is not adequate, even if present. It is for this reason that this amendment is made. Finally, necessary monitoring of possible failures of the means for ensuring uninterrupted flow can be safely provided by proper procedures; (3) the commentator cites the hazards of malfunction of the automatic device and the impracticability of a sophisticated device. Existing manual switching, plus any necessary procedures for monitoring the device, will minimize any malfunction hazard when compared with the hazard of unexpected flameout. As mentioned above, this amendment does not specify any degree of complexity but only requires that appropriate "design features" be incorporated.

An editorial change is made to §§ 25.955 (b), 27.955(b) and 29.955(b) to correct an apparent departure from former §§ 4b.413(c), 6.420(c), and 7.413(c) of the Civil Air Regulations. These former sections contained the words "if an engine can be supplied with fuel from more than one tank." Sections 25.955(b), 27.955(b), and 29.955(b) shortened this language, without intentional change, to "if an engine can feed from more than one fuel tank." To preclude any questions concerning the applicability of the affected regulations, the language of the former sections is adopted without substantive change. There is no comparable problem in Part 23.

The notice proposed to amend § 25.961 to require that fuel system hot weather operating capability be shown up to the maximum operating altitude established as an operating limitation, and to limit the climb airspeed of turbine engine powered airplanes to that established for climbing to the maximum operating altitude. One comment stated that the proposal is not necessary for airplanes certificated for use with booster pumps that maintain the fuel system at a pressure greater than the vapor pressure of turbine fuels, up to the maximum operating altitude. The Administrator agrees. This amendment therefore excepts fuel systems having that capability, but is otherwise drafted as proposed.

The notice proposed to amend § 25.965 by replacing the present fuel tank vibration requirement based on a factor (0.9) related to engine speed with a requirement based on a specific vibration frequency (2,000 c.p.m.). One comment objected to this proposal on the ground that it appears to be a relaxation that would downgrade safety. The Administrator disagrees. This amendment, like its predecessor, applies only where no frequency of vibration resulting from any r.p.m. within the normal operating range of engine speeds is critical. This amendment does not replace the survey of engine speeds conducted under § 25.965 (b)(3) (ii) and (iii) to determine that no critical condition is overlooked. For the purpose of the test covered by this amendment (that is, substantiation of the tank itself rather than substantiation of tank-engine combinations), a test frequency of 2,000 c.p.m., when imposed at the required test amplitude of $\frac{1}{32}$ inch, has been shown to be severe enough to ensure the integrity of the tank itself. This comment cannot, therefore, be accepted. This amendment is drafted as proposed.

The notice proposed to amend § 25.969 to provide that an automatic shutoff must be provided, for pressure fueling systems, as the means of showing compliance with the current requirement that it must be impossible to fill the fuel tank expansion space inadvertently. One comment objected for the following reasons: The commentator states that this means of complying with present § 25.969 should not be limited to the proposed automatic shutoff device and that such a limitation would involve unnecessary dictation of design with respect to the means for preventing the filling of the expansion space. The Administrator agrees. For this reason, and to locate all pressure fueling provisions together, this amendment places the automatic fuel content limiting means requirement in § 25.979(b) and, to avoid unnecessary duplication, provides in § 25.969 (which is otherwise unchanged) that "for pressure fueling systems, compliance with this section may be shown with the means provided to comply with § 25.979 (b)"; the commentator states that the substance of the proposed change is already covered in § 25.979(b). The Administrator disagrees. This proposal, like § 25.969, covers only the limitation of fuel quantity. Section 25.979(b), however, covers protection from damaging overpressures that may result if (1) the fuel quantity limiting means fails, or (2) overpressures are transmitted, without "failure" of the fuel quantity limiting means, such as could occur, for example, where air in the tank does not escape under an abnormally high fueling source pressure (so that fuel quantity itself does not exceed "approved" limits) and the air then becomes part of the means by which overpressures are transmitted to the fuel system.

The notice proposed to amend the fuel tank outlet requirement of § 25.977 to require that fuel tank outlet strainers in turbine fuel systems be fine enough in mesh to prevent the passage of any object that could restrict fuel flow or damage any fuel system component, to require that an alternate means be provided in turbine fuel systems to provide uninterrupted fuel flow if the main strainer could become blocked with ice, and to require that this alternate means provide a level of fuel system component protection equal to that provided by the main strainer. One comment stated that the requirement that the main strainer prevent the passage of any object that could restrict fuel flow or damage components, if strictly interpreted, would lead to ice blockage of the means to prevent interruption of the fuel flow. The Administrator agrees. However, it is for this reason that the alternate means in § 25.977(b) was proposed. No change from the notice is necessary in this regard. The comment also states that a four-mesh screen of adequate size has been found to provide proper protection for the fuel system from a standpoint of both extraneous material and icing, and states that a four to eight mesh size should be prescribed specifically. The Administrator disagrees. No single mesh size, or single range of mesh sizes, has been shown to be adequate for turbine fuel systems generally. Another comment stated that it supports this amendment but that the prescribed alternate should not be a screen if another means of showing safety equal to the main strainer is available. This comment specifically mentions a pump inlet screen bypassing arrangement that might prevent pump damage. The Administrator agrees that the words "equal to" should not be administered to automatically exclude any available means of showing equal protection.

One comment stated that a second strainer is the only available alternative that is equal in safety to the main strainer, that safety would not be advanced by requiring a second strainer since both strainers could collect ice, that an actual need to protect against foreign matter in the tanks simultaneously with icing is not operationally probable, and that the rule should require a "high degree" of protection rather than protection "equal to" that of the main strainer. The Administrator disagrees. Means other than strainers are not precluded under this amendment if protection equal to the main strainer is shown. The probability of simultaneous icing of an alternate strainer and the main strainer is slight enough to justify use of a strainer as an alternate. The words "high degree" of safety would not be appropriate since protection of the fuel system is best measured relative to the protection provided by the main strainer, which must be acceptable to the Administrator. These comments cannot, therefore, be accepted. This amendment is drafted as proposed.

The notice proposed to amend § 25.979 to cover all pressure refueling systems, to eliminate a reference to the fuel access cover plate, to more fully describe the means of preventing damaging overpressures, and to require that this means comply under the maximum fueling rates and pressures for which the system is designed. One comment objected for the following reasons: The commentator stated that the proposed detailed means of preventing damaging overpressures (that is, providing either proper tank vent sizing or an overflow valve) unduly dictates design. The Administrator agrees. This amendment therefore requires a means to prevent excessive pressures, without further prescribing the method of compliance (§ 25.979(c)). The commentator stated that the change to cover spillage from the "system" rather than from the "tank" would lead to added complexity without increased safety. The commentator appears to answer its own objection by then stating that highly reliable poppet check valves are commonly available to limit fuel spillage to nonhazardous amounts. No specific degree of complexity is intended or specified in this amendment. The commentator states that the proposal would preclude spillage of "minor" quantities of fuel from the refueling manifold. This comment is not understood, since the proposal concerns only "hazardous" quantities of spilled fuel. The commentator stated that the prohibition of spillage is inconsistent with the fact that large quantities of fuel may be spilled in order to comply with the proposed pressure relief requirement (proposed § 25.979(b)). The Administrator disagrees. The pressure relief provisions specifically apply only to conditions following failure of the prescribed fuel quantity limiting means. Thus, the fuel spillage resulting from pressure relief is tolerated only as a necessary means of preventing a significantly greater hazard, such as structural damage to the airframe which may not be detected before flight, and is tolerated only as a consequence of pressure relief requirements prescribed as a backup to the fuel quantity limiting means. The commentator suggested wording that would limit the fuel spillage requirement to "uncontrolled quantities." Since hazardous quantities may or may not be "controlled" in some way, the requested language would not be useful in preventing a hazardous situation and therefore cannot be adopted. This part of the amendment is therefore drafted as proposed (§ 25.979(a)). Section 25.979(b) contains the required automatic shutoff means for limiting tank content that was proposed as part of § 25.969. This means is placed in § 25.979, rather than § 25.969 as proposed, for the reasons covered in the discussion of § 25.969 (see above).

The notice proposed a new § 25.981 containing certain fuel system lightning protection requirements. In order not to delay the issue of the numerous rule changes of this amendment, action on this proposal will be taken separately. The final rule on lightning protection is now in the process of being prepared and will be issued shortly.

The notice proposed to add a new § 25.1003 providing that no temperature inside any fuel tank may exceed a specified temperature and requiring that compliance be shown for all normal and abnormal operations of all components that are inside any tank or that could transmit heat to any tank, including all possible malfunctions of those components. This amendment adds a new § 25.981, rather than § 25.1003, since this amendment affects fuel tanks only (rather than fuel systems). One comment stated that substantiation for all "possible" malfunctions and "combination of malfunctions" would be unduly difficult. The Administrator agrees. This amendment specifies only "probable * * * conditions." The comment also stated that specification of a temperature limit to cover all present and future fuels and conditions is undesirable. The Administrator agrees. This amendment therefore incorporates only "the highest temperature allowing a safe margin below the lowest expected autoignition temperature of the fuel in the tanks." Another comment requested that the proposal be eliminated because future design improvements and fuel requirements would require different maximum fuel temperatures. This amendment meets this objection by requiring prevention of fuel autoignition without prescribing a universal maximum temperature.

The notice proposed to amend § 25.1041 to require adequate cooling not only when the airplane is operating but also "after engine shutdown." One comment stated that there may be abnormal engine shutdowns, such as an emergency shutdown from a high power setting, following which temperature limits may be exceeded. This comment stated that the proposal should be narrowed to include only "normal" engine shutdowns. The Administrator agrees. This amendment is so drafted.

The notice proposed to amend § 25.1141 to require that no probable failure or "combination of failures" in any powerplant control system may cause the failure of any function necessary for safety, and that compliance must be shown by "fault analysis, component tests, and simulated environmental tests." One comment objected to the proposal because (1) "combination of failures" is contrary to the basic philosophy that the airplane need only be capable of continued safe flight and landing after a single failure, and (2) compliance with the requirement should not be required to be by "fault analysis, component tests and simulated environmental tests" since accepted practice is to use fault analysis alone unless tests are necessary to substantiate the validity of a particular analytical result. The Administrator does not agree with the first statement. It is not the policy of the Administrator to ignore a probable combination of failures whose result would be hazardous. The Administrator does, however, agree with the second statement. A combination of means of showing compliance is therefore permitted under this amendment. In addition, two changes to the notice are made to more accurately express its intent. First, the prescribed failed "function" is limited to "powerplant function." Secondly, the words "failures or combination of failures" in the system is changed to include "malfunctions." The notice did not intend to raise a technical or semantic distinction between a powerplant control system "failure" and "malfunction" where their common result is discontinuance of an essential powerplant function.

The notice proposed to amend § 25.1153(b) to require only that "inadvertent" movement of the propeller control to the feathering position be prevented (rather than positive prevention of such movement as the rule currently required). One comment objected to this change as an undesirable relaxation. The Administrator disagrees. The present rules for propeller feathering controls generally (in § 25.1153(a)) and for reverse thrust controls (in § 25.1155) cover only "inadvertent" control operation. No higher standard has been shown to be necessary for propeller pitch or speed controls used for feathering. This amendment is drafted as proposed.

The notice proposed to broaden § 25.1155 to cover controls for propeller pitch settings below the flight regime, not just reverse thrust controls. One comment stated that the degree of complexity of such controls in a certain currently operational aircraft should not be exceeded in the administration of this amendment. This amendment is not intended to dictate any specific degree of complexity. Another comment objected, stating that this amendment relaxes the present rule by using the word "inadvertent." No relaxation results. The word "inadvertent" is used in the present rule. This amendment in fact increases a burden by extending § 25.1155 to cover controls heretofore not covered by the regulations. This amendment is drafted as proposed.

The notice proposed to delete § 25.1181 (c) and place its provisions, with certain amendments, in a new § 25.1182. One comment objected, stating that the fire protection requirements applicable to nacelle areas behind firewalls need not be extended to engine pod attaching structures because the present requirements have provided a superior level of safety for turbojet powered large airplanes and no record of fires in these structures is known. The Administrator agrees concerning the superior level of safety and good service record of engine pod attaching structures with respect to fire. However, this level of safety has resulted through the voluntary incorporation by industry of engine pod attaching structure design provisions meeting the fire protection provisions of §§ 25.1195 through 25.1201 (except those requiring fire detection and extinguishing). The Administrator agrees with one comment stating that safety does not require that engine pod attaching structures have fire detection and extinguishing provisions, and that those structures may be distinguished from nacelle areas behind the firewall in this regard. To this extent, the industry comment is accepted and this amendment is drafted accordingly. The commentator stated that the "firewall definition" paragraphs are not relevant for the fire zone, that the "internal boundaries" are not clearly defined, and that this will lead to ventilation, containment, and fire extinguishing system difficulties. The intent of this comment is not clear. However, there should be no difficulty in defining the area covered by the term "engine pod attaching structure." Further, the Administrator does not agree that the firewall provisions are irrelevant to this structure. For this structure, as well as for reciprocating engine installations, the firewall separates the engine nacelle from the airframe in compliance with the provisions of § 25.1191. Finally, the claimed relationship between the firewall defining provisions and possible future difficulties in ventilation, containment, and fire extinguishing is neither supported nor evident. This comment cannot, therefore, be accepted.

One comment requested that an exception should be provided (1) for engine pod attaching structures where the firewall between pod and pylon extends enough beyond the profile of the pylon to prevent propagation of fire from the pod area around the firewall to the pylon zone, and (2) for installations that have means to prevent contact of leaking flammable fluid with a hot firewall. The Administrator agrees that these safety provisions may be relevant in individual showings of equivalent safety that may justify design alternatives to the sections referenced in § 25.1182. However, within the terms framed by the commentator, these safety provisions are not sufficiently definable to permit a general exception in the regulation. This comment cannot, therefore, be accepted.

No adverse comments having been received, the proposed change to §§ 23.1183, 25.1183, 27.1183, and 29.1183 (concerning lines and fittings approved as part of an engine) is drafted as proposed.

The notice proposed to add a new § 25.1305(x) to require "a means, for each air turbine engine starter not designed for continuous use, to indicate to the flight crew when that starter is energized." One comment stated that, for starters designed to contain failures of high energy rotating parts, no indicator should be required because no hazard would result even if the starter is not designed for continuous operation. Another comment stated that numerous possible factors, such as use of starters that cannot be used continuously, protection by starter location, and containment of failed components should obviate the need for an indicating means regardless of whether the starter is designed for continued operation. The Administrator agrees with these comments. This amendment therefore covers only starters that can be used continuously but that are neither designed for continuous operation nor designed to prevent hazard if they fail.

No adverse comments having been received, the proposed amendment to §§ 23.1585, 25.1585, 27.1585, and 29.1585 (concerning fuel system operating procedures) is drafted as proposed.

In consideration of the foregoing, Subchapter C of Chapter I of Title 14 of the Code of Federal Regulations is amended, effective June 4, 1967, as follows:

(Secs. 313(a), 601, 603, Federal Aviation Act of 1958; 49 U.S.C. 1354(a), 1421, 1423)

Amendment 27–2

Rotorcraft Type Certification Requirements

Adopted: January 19, 1968 **Effective: February 25, 1968**

(Published in 33 F.R. 956, January 26, 1968)

The purpose of these amendments is to improve the airworthiness requirements applicable to the type certification of rotorcraft.

These amendments are based on, and reflect comments from interested persons concerning, the notice of proposed rule making published in the FEDERAL REGISTER (30 F.R. 16129) on December 28, 1965, and circulated as Notice 65–42.

Numerous comments were received in response to Notice 65–42. Based upon these comments and upon review within the FAA, a number of changes have been made to the proposed rules. These changes to the proposals and the FAA's disposition of public comments are set forth hereinafter. Interested persons have been afforded an opportunity to participate in the making of this amendment, and due consideration has been given to all matter presented.

Flight. The notice proposed to add a new speed symbol "V_{FV}" (maximum speed for freedom from rotor flutter and vibration) to Part 1, and amend Parts 27 and 29 to accomodate the new speed V_{FV}. Analysis of comments indicates that incorporation of the new speed V_{FV} in Parts 27 and 29 requires further study. The proposals concerning speed V_{FV} are therefore withdrawn. The notice also proposed to amend the definition of V_H. One comment stated that the proposed definition should be changed by deleting the reference to engine speed since it is not essential in addition to the term "maximum continuous power." The FAA agrees. This amendment is therefore drafted as proposed with the exception of the reference to engine speed.

The notice proposed to broaden the center of gravity limits prescribed in §§ 27.27 and 29.27 to cover the entire envelope of lateral as well as longitudinal limits. One comment stated that determination of lateral center of gravity limits should be required only if laterally displaced external stores could result in extreme lateral loadings. The FAA agrees that an entire envelope of lateral and longitudinal limits need not be established in every case and that lateral limits should be established only if critical. However, if critical, it is not relevant whether those limits involve external or internal loading conditions. Amended §§ 27.27 and 29.27 therefore prescribe extreme lateral centers of gravity "where critical."

The notice proposed detailed amendments to the main rotor speed and pitch limit provisions of §§ 27.33 and 29.33. No adverse comments having been received, these amendments are drafted as proposed.

The notice proposed to amend § 29.67 (a)(2) to require that the currently prescribed rate of climb of 150 feet per minute for Category A rotorcraft be available, 1,000 feet above the takeoff surface, for each weight and temperature for which takeoff data are to be scheduled. One comment objected for several reasons: The commentator stated that the 1,000-foot figure is arbitrary and is not consistent with helicopter operations. The FAA disagrees. The purpose of the 1,000-foot requirement is to provide a margin of climb performance at all altitudes outside of ground effect, not only at the 1,000-foot altitude itself. This minimum margin is not arbitrarily determined since experience has shown that lesser margins can result in hazardously low rates of climb under conditions deviating from ideal conditions. Considered as increasing the margin of climb performance for all operations, the 1,000-foot requirement is in no way inconsistent with normal helicopter operations. The commentator stated that more climb performance to compensate for turbulence should not be necessary since the present 150-foot-per-minute climb rate was originally established for this purpose.

The FAA disagrees. The climb performance margin created by the 150-foot-per-minute requirement has been shown to be insufficient to ensure adequate performance under expected conditions of turbulence. The commentator states that the 1,000-foot altitude requirement should be an operations requirement rather than a type certification requirement since circling altitude requirements are the concern of FAA operations inspectors rather than FAA type certification personnel. The FAA disagrees. The 1,000-foot altitude requirement is not intended to substantiate the rotorcraft for a particular altitude or to prescribe an operating altitude of any sort, but is rather intended to increase the climb performance margin of the rotorcraft, under less than ideal conditions, during operations at all altitudes. This is properly a type certification function. This amendment is therefore drafted as proposed, with one exception: The notice proposed to require that the climb performance be shown for each "weight and temperature" for which takeoff data are to be scheduled. The present rule requires that this be shown for each "weight, altitude, and temperature". It was not intended that the conditions of substantiation be changed from the former rule with respect to altitude as an aspect of takeoff data scheduling by the applicant. Section 29.51(a) requires that the takeoff data required by § 29.67(a)(2) must be determined at each "weight, altitude, and temperature" selected by the applicant. The applicant must thus in any case include his choice of altitude in his selection of conditions under which takeoff data are "to be scheduled" under § 29.67(a)(2). This being the case, no substantive change would result from including "altitude" in § 29.67(a)(2). This is therefore done to avoid an inference of intent to change the present rule with respect to altitude as a test condition that the applicant schedules as part of the established takeoff data.

The notice proposed to amend § 29.73(b)(2) to require single engine turbine engine powered Category B helicopters to have a hovering ceiling of at least 2,500 feet, in standard atmosphere plus 40° F., at maximum weight. Standards for multiengine, turbine engine powered Category B helicopters were also proposed. One comment objected, stating that hovering performance should not be a criterion for helicopters, and stating that the proposed requirement for single engine turbine engine powered helicopters is more restrictive than the present 4,000-foot density altitude requirement at temperatures above 30° C. at sea level and certain lower temperatures at altitude. The FAA agrees that the value of hovering performance as a criterion should be reevaluated for helicopters generally throughout the regulations. However, until this is done, the hovering performance for turbine engine powered helicopters at high operating temperatures should be no less than that of reciprocating engine powered helicopters. This amendment accomplishes this result. It is recognized that, for turbine engine powered helicopters, compliance with the amendment may result in a hovering performance higher than that of piston engine powered helicopters at standard temperatures. The FAA believes, however, that increased hovering performance of turbine engine powered helicopters must be accepted at normal temperatures in order to ensure that, at high temperatures, such performance will not be less than that of a piston engine powered helicopter as a result of meeting the present 4,000-foot standard temperature requirement. This amendment is drafted as proposed.

The notice proposed to amend § 29.75(b)(4) to specifically permit approach and landing paths to enter critical areas of the limiting height-speed envelope established under § 29.79. Where such an envelope is specifically limited to operations other than approach and landing, this proposal is not necessary. Where such an envelope is not so limited, further study is necessary to redefine the operating limitations to be derived from the envelope, under approach and landing conditions, under § 91.31(b)(9). This proposal is therefore withheld pending such study.

The notice proposed to delete § 29.75(b)(6). No adverse comments having been received, this amendment is adopted as proposed. Consistent with this change, § 29.75(c)(2)(ii) is amended by deleting the cross reference to (b)(6).

The notice proposed to add a new section prescribing water landing capability for rotorcraft for which approval for overwater operation is requested. In the light of comments received, this proposal is withdrawn pending further study of the airworthiness and operations aspects of overwater operation.

The notice proposed to amend § 27.79 to require that no point on the low speed side of the limiting height-speed envelope may exceed V_Y. In the light of comments received, it is felt that the proposal could in some cases lead to unconservative envelopes being established, which may more than offset the advantages to be obtained by the proposal. Where the envelope has a satisfactory corridor, it is not clear that pilot tendency to climb within the critical area of the envelope must be assumed to exist merely because V_Y is within that area. The pilot has knowledge of the envelope as performance information. This proposal is therefore withdrawn pending further study of the operational consequences of the location of V_Y within the envelope.

The notice proposed to amend §§ 27.141 and 29.141 with respect to the provision that sudden powerplant failure must be assumed. This amendment, as explained in the notice, is based on the assumption that sudden, complete power failure is a probable operating condition for rotorcraft that do not meet Transport Category A engine isolation requirements and that sudden failure of one engine is a probable operating condition for rotorcraft that do meet those requirements. One comment objected, stating that turbine engines are less prone to sudden failure than are reciprocating engines and should therefore not be assumed to fail suddenly. The FAA disagrees with the commentator's conclusion. Sudden failure is a necessary assumption since such failure is possible and can lead to adverse flight or control characteristics regardless of the kind of engine. These amendments are drafted as proposed.

The notice proposed, in part, to replace a requirement for a demonstration of control at "maximum weight" in §§ 27.143 and 29.143 with a requirement for a demonstration at "critical weight." No adverse comments having been received, this proposal is drafted as proposed (§§ 27.143(b)(1) and 29.143(b)(1)). The notice also proposed to amend those sections to require a controllability demonstration in uncoordinated flight. This proposal is withdrawn in the light of comments received.

The notice proposed to amend §§ 27.143 and 29.143 with respect to controllability after power failure. No adverse comments having been received, these amendments are drafted as proposed.

The notice proposed to amend §§ 27.173(b) and 29.173(b) to prohibit a negative stick position versus speed slope except for hovering and to restrict the negative stick travel in the hovering condition to not more than 1 inch measured at the top of the pilot's normal hand position. One comment objected for several reasons. The commentator stated that the hazards of negative stick stability should be determined on a case-by-case basis.

The FAA disagrees. Except for the hovering condition, a negative stick slope is known to be undesirable regardless of the severity of the slope. This is particularly true with respect to the trend of current rotocraft to operate at higher speeds and under instrument flight conditions. This is also true with respect to pilot fatigue. Flight safety may be directly affected by negative static longitudinal stability in any rotorcraft in climb, cruise, and autorotation. It would therefore be inappropriate to require a detailed investigation of the results of such instability on each type design. This comment cannot, therefore, be accepted. The commentator stated that the permitted negative stick travel in the hovering condition should be 10 percent of total stick travel rather than 1 inch for all type designs. The FAA disagrees. Helicopters may vary widely in total stick travel. The amount of negative stick travel being a percentage, would thus also vary widely from helicopter to helicopter. This may adversely affect the piloting responses of a pilot who operates more than one type of rotorcraft. A fixed percentage may also result in large absolute values of negative stick travel that are potentially unsafe in the hovering condition. This comment cannot be accepted. The commentator stated that elimination of negative stick travel in climb and cruise may result in more aft longitudinal control at V_{NE}, which could permit the pilot to pull higher load factors and greater nose-up attitudes than would be possible at present. While possibly correct, this comment is not accepted since piloting response can safely deal with high speeds in a helicopter that has positive static longitudinal stability whereas the effects of permitting negative stability may be undesirable through a wide speed range. This amendment is drafted as proposed.

The notice proposed to amend §§ 27.175 and 29.175 to require that the static longitudinal stability of multiengine rotorcraft be shown with a rate of descent of 1,000 feet per minute rather than in autorotation as currently required. This proposal was in response to the fact that a 1,000 feet per minute rate of descent is a representative flight condition for multiengine rotorcraft whereas autorotation is not. This is correct. However, other regulations, such as § 29.75(b)(5) and (c)(1)(ii) require that complete power failure be accounted for in the case of multiengine rotorcraft in Category A and Category B. These regulations are based on the assumption that total power failure, while rare, must be regarded as a real possibility to be taken into account from a performance point of view. It would be inconsistent to require the substantiation of the performance of multiengine rotorcraft in autorotation because of the possibility of total power failure and at the same time dispense with substantiation of safe static longitudinal stability under the same conditions. This proposal is withdrawn pending further study of operating assumptions underlying the autorotation requirements for multiengine rotorcraft.

The notice proposed to amend the power requirement for demonstrating static longitudinal stability in the hovering condition under §§ 27.175 and 29.175. No adverse comments having been received, these amendments are drafted as proposed.

The notice proposed to amend the pilot compartment view requirement of § 29.773 with respect to the first pilot's position. No adverse comments having been received, this amendment is drafted as proposed.

The notice proposed to add new §§ 27.1322 and 29.1322 covering warning, caution and advisory lights. No adverse comments having been received, these amendments are drafted as proposed.

The notice proposed, in part, to delete the requirement in § 29.1323(b)(2) that the airspeed indicating system must be calibrated "in ground effect, during the accelerated takeoff run," and replace it with a requirement that the system be calibrated, "during takeoff," so as to provide indications that can ensure consistent realization of specified field lengths and ensure avoidance of the critical areas of the limiting height-speed envelope. One comment objected to this part of the proposal for the following reasons: The commentator states that system calibration should not be required "during takeoff" since this involves calibration in a flight realm that the explanation in the Notice states is difficult. The FAA disagrees. While it is true that this amendment involves calibration in flight, it was calibration in ground effect, not in all flight conditions, that was stated to be difficult. The commentator states that the calibration requirement should be discontinued and that only field length and height-speed safety should be considered during takeoff demonstrations conducted under § 29.51. The FAA disagrees. Calibration of the airspeed indicating system is the only means of ensuring repeatability of airspeed indications so as to obtain consistent realization of specified field lengths and avoidance of critical height-speed combinations. This part of the proposal is therefore drafted as proposed. The Notice proposed, in part, to change several speed references from miles per hour to knots. One comment stated that references to "five m.p.h." should be changed to an even "five knots" to avoid a fractional knot requirement, which would assume unrealistic airspeed indicating accuracy. This comment is accepted. Except for this change from the notice, this part of the proposal is drafted as proposed. The notice proposed, in part, to delete the words "including the airspeed indicator instrument calibration error" from the airspeed error provisions of § 29.1323 (c) and (d). One comment objected, stating that, unless the accuracy of the system includes indicator calibration error, it would not be possible to know the total error in the system. The FAA disagrees. Total error can be obtained by separately determining system error and indicator error. Further, this method of determining total error, by separately identifying the system and indicator errors, more adequately permits future determinations of total error when the original indicator is replaced with another having a different instrument error. This part of the proposal is drafted as proposed. The notice also proposed to raise the low speed calibration speed in § 29.1323(c)(1) from 10 m.p.h. to 30 knots and that in § 29.1323(d) from 10 m.p.h. to 20 knots (including the change from miles per hour to knots) in order to ease the difficulty of low speed calibration while still obtaining a calibration speed allowing consistent avoidance of hazardous height-speed combinations during takeoff. One comment stated that raising the minimum calibration speeds would not assure avoidance of hazardous height-speed combinations during takeoff. This comment is not accepted. For takeoff, avoidance of the critical areas of the limiting height-speed envelope would be ensured under amended § 29.1323(b)(2), which requires that the airspeed indications for this flight condition be repeatable and readable. Experience in the type certification of multiengine transport category rotorcraft indicates that compliance with the airspeed accuracy requirements below 30 knots is not feasible. Further, for the forward flight conditions of § 29.1323(c)(1) and (d), calibration down to 30 knots and 20 knots, for multiengine and single engine rotorcraft, respectively, is sufficient to avoid hazardous height-speed combinations and will avoid unnecessarily difficult airspeed calibration down to 10 m.p.h. This part of the proposal is drafted as proposed. Several suggestions for further amendment of the airspeed calibration requirements were received. These suggestions are appreciated. However, they go beyond the scope of the notice and will be reserved for future consideration.

The notice proposed to amend § 29.1329(d) to allow autopilot malfunctions to create speeds up to 1.05 V_{NE} if the stability curve is positive to 1.1. V_{NE}. One comment requested that 1.1 V_{NE} be permitted. The speed V_{NE} is chosen to ensure a margin of safety between it and the highest speed shown to be safe. It is thus essential that the conditions under which V_{NE} may be exceeded be precisely described in the rules if such an allowance is to be given. The only controlling condition in § 29.1329(d) is that corrective action is assumed to begin within a "reasonable period of time." It is clear that the safety of any speed permitted above V_{NE} depends entirely upon the conservatism of the time administered under the language "reasonable period of time." This is true regardless of whether 1.05 V_{NE} or 1.1 V_{NE} is permitted. The time for pilot response may be particularly critical in the high altitude, low V_{NE} condition. This proposal is therefore withdrawn pending further study of the time delay aspects of automatic pilot system failures at high speeds.

The notice proposed to amend §§ 27.1505 and 29.1505 to provide for variations in V_{NE} with respect to altitude, r.p.m., temperature, and weight. No adverse comments having been received, these amendments are drafted as proposed.

The notice proposed to amend § 27.1519 to require that either (1) the limiting height-speed envelope be shown to be satisfactory, at each altitude, at the highest weight allowing hovering in ground effect at that altitude, or (2) if lesser weights are demonstrated for any altitudes, these lesser weights be established as operating weight limitations for those altitudes. One comment stated that since the envelope derived under Part 27 is performance information and is not an operating limitation, no information derived from the envelope should be an operating limitation. The FAA disagrees. The value of the envelope as performance information depends entirely upon whether the envelope information provides a basis for the pilot to adequately determine the limits of safe operation. For any given altitude, the envelope provides no firm basis for pilot decision making at weights above those at which the envelope is developed for that altitude. Section 27.79(a)(2) permits the applicant to select any weight for each altitude. This amendment does not alter this flexibility with respect to weight to be demonstrated. This should be left to the applicant. But the ability of a helicopter to operate at weights above the selected weight must be considered since there may be a significant incentive to operate a rotorcraft at the limits of its takeoff capability. This amendment is drafted as proposed except that cross-references to §§ 27.73 and 27.79 are added for clarity.

The notice proposed to delete empty weight items from the Rotorcraft Flight Manual provisions of §§ 27.1583(c) and 29.1583(c). No adverse comments having been received, these amendments are adopted as proposed.

Airframe. The notice proposed to include "design maximum altitude" as a "design limitation." One comment stated that altitude should not be treated as a "design limitation." The FAA agrees that the intent of the proposal (which is to ensure that the effect of altitude on rotorcraft fatigue strength will be accounted for) can be achieved by requiring that altitude effects be accounted for without designating a "design maximum altitude." This proposal is therefore withdrawn. The requirement to account for altitude effects has been reproposed, together with amendments proposed under airframe proposal 8 of Notice 65-42, in a separate notice of proposed rule making (Notice 67-44, published in the FEDERAL REGISTER (32 F.R. 14106)) on October 11, 1967.

The notice proposed to add a new § 29.473(c) concerning triggering or actuating devices for supplementary landing load absorption. No adverse comments having been received, this amendment is drafted as proposed. One comment requested that this amendment be considered for Part 27. This comment is accepted. An identical proposal for public comment will be considered for amendment of Part 27.

The notice proposed to amend § 27.473 (a)(1) to allow a rotor lift of two-thirds of the design maximum weight in establishing limit ground loads. No adverse comments having been received, this amendment to § 27.473(a)(1) is drafted as proposed. The notice further proposed to limit the rotor lift to two-thirds of the design maximum weight under Parts 27 and 29 by eliminating the reference to "any greater lift proven to be appropriate" in §§ 27.473(a)(2) and 29.473 (a)(2). One comment objected, stating that this change would inhibit certain benefits of advancing rotor technology. This is not the case. Section 21.21(b)(1) provides that any provision not complied with may be compensated by factors that provide an "equivalent level of safety." For rotorcraft for which such "equivalent level of safety" is shown for the specific technological advances mentioned by the commentator, this amendment causes no substantive change and (a)(2) is surplus. For rotorcraft for which such showings cannot be made, present (a)(2) is misleading, since it assumes that a greater fractional rotor lift may be "appropriate" even though an "equivalent level of safety" cannot be shown therefor. More than a decade of type certification programs conducted under the current rules indicates that two-thirds of design maximum weight is the highest rotor lift acceptable, as a general rule, for establishing limit ground loads. This amendment is therefore drafted as proposed.

Editorially, these amendments result in the elimination of subparagraphs under paragraph (a) of §§ 27.473 and 29.473.

The notice proposed to delete the cross references to §§ 27.727 and 29.727 from §§ 27.473(b) and 29.473(b), respectively, since limit inertia load factors are not substantiated under those sections. No adverse comments having been received, this change is made as proposed.

The notice proposed to add a new § 29.501 providing standards for skid landing gear. No adverse comments having been received, this amendment is drafted as proposed.

The notice proposed to delete § 27.501 (c)(2)(ii) which required that ground loads must pass through the center of gravity. No adverse comments having been received, this amendment is adopted as proposed.

The notice proposed to add a new § 29.511 covering unsymmetrical loads on multiple-wheel landing gear units. No adverse comments having been received, this amendment is drafted as proposed.

The notice proposed to add new §§ 29.519 and 29.757, and amend §§ 29.521, 29.755, and 29.803, all concerning substantiation of amphibian and limited amphibian rotorcraft. Comments objected to the inclusion of a flotation time requirement in § 29.755(b), stating that flotation time is entirely an operational problem. The FAA agrees that flotation time is an important operational consideration and must be responsive to different operating conditions. However, it is also clear that some minimum flotation time must be prescribed for all operations since a form of amphibian approval is involved. One half hour is believed to be a reasonable time, and should present no difficulty for any hull that meets the structural requirements in these amendments. Section 29.755(b) therefore requires that the rotorcraft be able to remain afloat for one half hour.

The notice proposed to amend the fatigue evaluation provisions of Part 29 to permit manufacturers to adopt failsafe design practices on certain conditions. The proposal has been amplified and reproposed, together with appropriate operating rule changes, in Notice 67-44, published in the FEDERAL REGISTER (32 F.R. 14106) on October 11, 1967, for the reasons contained therein.

The notice proposed to require that each engine mount and adjacent structure to be designed to withstand the loads resulting from a limit torque equal to 1.25

times the mean torque for 2½-minute power combined with 1g. flight loads. One comment stated that a certain higher flight loading should be required. The FAA disagrees, since the 2½-minute rating is intended to take care of the relatively infrequent case of engine failure during takeoff and approach to landing. For this contingency, the proposed flight loading is adequate. This amendment is drafted as proposed.

The notice proposed to require dual locking devices on all fasteners whose function is necessary for safety. In response to comments received, this proposal is withdrawn. The material in this item has been reproposed in Notice 67–49, published (32 F.R. 15676) on November 14, 1967.

The notice proposed to amend §§ 27.653 and 29.653 to except certain sealed rotor blades. No adverse comments having been received, these amendments are drafted as proposed.

The notice proposed to amend §§ 27.653 through 27.661, and §§ 29.653 through 29.661 to cover all rotors, not just main rotors. No adverse comments having been received, these amendments are drafted as proposed.

The notice proposed to amend §§ 27.659 and 29.659 to require substantiation of the mass balance installation. No adverse comments having been received, these amendments are drafted as proposed.

The notice proposed to add new §§ 27.663 and 29.663 containing reliability and damping action investigation requirements for ground resonance prevention means and to require that specific maintenance standards for this means must be approved under §§ 27.1529 and 29.1529. One comment requested that the requirement in proposed paragraph (b) to consider the "probable" range of service variations should be changed to refer to the "allowable" range. This comment is not accepted since the objective is to establish the variations expected in service. The commentator also stated that the requirement in proposed paragraph (b) to investigate the range of probable variations "in flight" should be broadened to allow other testing. The FAA agrees. The words "in flight" are therefore omitted from §§ 27.663(b) and 29.663(b). One comment objected to the proposal to require approval of specific maintenance practices. The FAA agrees that the current requirement to place recommended maintenance procedures in the Maintenance Manual under §§ 27.1519 and 29.1519 is sufficient. Separate approval of those practices is not necessary for ground resonance prevention means.

The notice proposed to amend § 29.725 (a) to require only an 8-inch drop height with no contact velocity prescribed. No adverse comments having been received, this amendment is drafted as proposed.

The notice proposed to amend §§ 27.751 (b) and 29.751(b) to provide capsize protection for main floats. No adverse comments having been received, these amendments are drafted as proposed.

The notice proposed to amend the pilot compartment requirements of § 29.771 by deleting the requirement for a passageway between the pilot compartment and the passenger compartment (paragraph (e)) and the requirement for a means to prevent passengers from entering the pilot compartment without permission (paragraph (f)). No adverse comments having been received, these amendments are adopted as proposed.

The notice proposed to amend § 29.805 to require that the flight crew emergency exit rapid evacuation capability must be shown by test. No adverse comments having been received, this amendment is drafted as proposed.

The notice proposed to amend §§ 29.807 through 29.813 to update the emergency exit requirements. In response to one comment, the amended table in § 29.807 (b) contains the same headings as the current table. There was no intent to change the headings of the table, although no headings were included in the table in the notice. One comment objected to the allowance, in the table of one Type IV exit per side for passenger seating capacities of 1 through 10, stating that no exit should be smaller than a Type III exit. The FAA disagrees. Experience with airplanes has demonstrated that one Type IV exit per side is adequate for the prescribed seating capacity. The notice proposed to amend § 29.807 to allow the substitution of one Type I or Type II exit in the floor ramp of rear ramp rotorcraft, instead of in the sides of the fuselage, if the aft exit meets § 29.813. One comment stated that the rule should make it clear that only one exit may be substituted, even though that exit may be a Type I or Type II exit. This is in accord with the intent of the proposal. Amended § 29.807(d) is therefore limited to "one Type I exit only, or one Type II exit only". The notice proposed to add a new § 29.809(f)(1) requiring that evacuation ropes must have a specified diameter. It is now felt that the static load and attachment requirements also proposed for evacuation ropes (proposed (f) (2) and (3)) make any specified diameter unnecessary. Proposed (f)(1) is therefore withdrawn and the remaining subparagraphs are renumbered accordingly. Further, the FAA has determined that the prescribed evacuation assist means are not necessary for overwing exists since the wing (including stub wings to be expected on compound helicopter) itself provides a passageway to the ground. Section 29.809(f) is therefore changed from the notice to specifically except such exits.

Proposed § 29.811(h) referred to each exit "that is required to be openable from the outside." Since § 29.809(b) requires each emergency exit to have this characteristic, the quoted language is surplus and is deleted from amended § 29.811(h)

Proposed § 29.811(h)(1) specified that each exit must be outlined with 2-inch colored band. One comment suggested that this provision also include a requirement for a crash locator light visible outside of the window. This comment goes beyond the scope of the notice and therefore cannot be accepted. However, the proposal is changed in this amendment to cover only passenger emergency exits. It was not intended to require the 2-inch band marking for crew exits.

Proposed § 29.811(h)(2) provided that outside markings be such that the reflectance of the lighter color must exceed that of the darker color by a factor of at least three. Where the reflectance of the darker color exceeds 15 percent, the proposal is unduly severe. This amendment therefore permits a reflectance differential of 30 percent in such cases. On the other hand, study since the notice indicates that the factor of 3 to 1 is not sufficient to ensure safe visibility where the reflectance of the darker color is 15 percent or less. For these low reflectance values, safety requires that the reflectance of the lighter color must be no less than 45 percent. This change from the notice is necessary to achieve minimum acceptable conspicuity under emergency evacuation conditions.

One comment suggested amending § 29.813, to make it clear that the requirement for "unobstructed" passageways between passenger compartments and "unobstructed" passageways leading to Type I and Type II emergency exits means "unobstructed" by maximum seat positions either reclined or broken over. No difficulty in administering the current "unobstructed" provision has been experienced in this regard. This comment is not accepted.

The notice proposed to amend § 29.813(b) to include the assumption that all passengers are ambulatory. Since that paragraph is only concerned with the amount of space required for a crewmember to assist in evacuation "without reducing the unobstructed width of the passageway" it is evident that the space requirements of crewmembers, not the condition of passengers, is the only regulatory concern of § 29.813(b). This proposal is therefore withdrawn.

The notice proposed to amend § 27.807(a) to delete the reference to seating capacity. No adverse comments having been received, this amendment is adopted as proposed.

The notice proposed to amend § 29.853(f) to prescribe at least three hand fire extinguishers for rotorcraft with passenger seating capacities greater than 60. No adverse comments having been received, this amendment is drafted as proposed.

The notice proposed to require that doors and windows of cargo and baggage compartments must be lined with fire resistant materials in addition to the current requirement in § 29.855(a) that those compartments themselves be so lined. This proposal is withdrawn in agreement with comments received. No further detailed lining requirement is necessary since the doors and windows are part of the compartment and, as such, are adequately covered by current § 29.855(a). The notice also proposed to amend § 29.855(d) to make that paragraph specifically applicable only to compartments that are not sealed against fire and to compartments intended for cargo only. One comment stated that the requirement to prevent the "entry" of noxious gases into crew and passenger compartments should be amended to make it clear that compliance may be shown by devices that prevent retention of gases that have entered. The FAA agrees. The purpose of this portion of the rule is to ensure that harmful quantities of noxious gases do not accumulate in crew or passenger compartments. This amendment therefore uses the word "accumulation" in place of the word "entry." The notice finally proposed a new § 29.855(e) containing additional requirements for cargo-only rotorcraft. This amendment is drafted substantively as proposed.

The notice proposed to specifically express the intent of §§ 27.1565 and 29.1565 to provide conspicuity under daylight conditions only. One comment requested that night conspicuity also be required. This comment goes beyond the scope of the notice but will be considered for future rule making. No other adverse comments having been received, §§ 27.1565 and 29.1565 are amended as proposed.

Powerplant. The notice proposed to amend §§ 27.901 and 29.901 to require that "axial and lateral expansion of turbine engines may not affect the safety of the installation." No comments objecting to the intent of this proposal having been received, new §§ 27.901-(b)(4) and 29.901(b)(5) are drafted, as proposed, with one minor clarifying change: The word "lateral" is replaced with the word "radial" since the latter word is the more appropriate counterpart of the word "axial." No substantive change results.

The notice proposed to amend the engine stoppage requirement of § 29.903(c) to except turbine engines whose stoppage is not necessary for safety. No adverse comments having been received, this amendment is drafted as proposed.

The notice proposed to amend §§ 27.923 and 29.923 to require substantiation of accessory drive pads under the rotor drive system and control mechanism tests. Where identical pads are involved, the proposal would have permitted the loading of one pad only. Study indicates that this may not be appropriate in every case, and that adequate standards for the substantiation of drive pads would exceed the scope of the notice. These changes are therefore withdrawn and will be reproposed in greater detail.

The notice proposed to amend § 27.923 to require that the rotor system endurance test include a clutch endurance test in which at least 200 "clutch engagements" are accomplished in a certain manner. One comment suggested that more than 200 engagements should be prescribed. The FAA believes that 200 engagements is sufficient to simulate conditions that would exist in service and to substantiate the clutch mechanism for those conditions. This comment cannot, therefore, be accepted. This amendment is drafted as proposed, with one exception: The proposed words "clutch engagements" are changed to read "start-up clutch engagements". This amendment is intended to cover only the start-up (engine accelerating) clutch, not the overrunning (freewheeling) clutch.

The notice proposed to add new §§ 27.923(j) and 29.923(o) to require that the rotor system endurance test include substantiation of the system for certain overboost conditions. One comment generaly concurred, with the following exceptions: The commentator stated that the proposal would require a low temperature operating facility or else test procedures to allow the proposed torque requirements to be met under the normal range of temperatures. The commentator then suggested language changes under which the engines would not be operated above their approved ratings. Under certain conditions, these suggested lauguage changes might not result in substantiation of the system for torque loads above the approved ratings and might therefore prevent the desired evaluation of overboost conditions. The commentator is correct in stating that either a low temperature facility, or procedures to achieve overboost conditions under normal temperatures, are necessary under the proposal. However, the need to obtain overboost conditions requires that the commentator's suggested language be rejected. The commentator stated that the proposal was wrong in assuming that there is no direct control of engine power output by the pilot, because such control in fact exists. It is recognized that power limits are closely followed and controlled during most operations. However, these amendments are necessary to ensure safe operation in conditions under which the pilots are likely to be distracted by an emergency or are forced to exceed power limitations in order to maintain safe flight. For these conditions, it must be assumed that the transmission may be subjected to torque values exceeding those obtainable within approved engine ratings. For these possible overboost conditions, this comment cannot be accepted. These proposals are drafted as proposed, with one relaxing change: The notice would have added these amendments to §§ 27.923 and 29.923. Under § 29.923(a)(2) this would have required that the overboost test under Part 29 be conducted on the rotorcraft, which might result in damage to the engines. One industry comment correctly objected to this aspect of the proposal. Amending §§ 27.923 and 29.923 would also have required the overboost test to be done as part of the endurance test. Neither of these consequences are necessary to the substantiation of the transmission itself for temporary overboost conditions. This is the sole purpose of these amendments. They are therefore drafted as new §§ 27.927(b) and 29.927(b) rather than as amendments to §§ 27.923 and 29.923. New § 27.927(b)(3) and 29.927(b)(3) specify the conditions under which the test need not be conducted on the rotorcraft. The present language in §§ 27.927 and 29.927 is designated as paragraph (a) without substantive change. These amendments also make it clear that, in determining maximum attainable torque for the purpose of the overboost test, it may be assumed that torque limiting devices, if any, function properly. Finally, the words "torque output of the engines" in the proposal for the all-engines operating case are replaced with the words "torque attainable under probable operating conditons" for consistency with the language describing the engine-inoperative test. No differences between the two test conditions, with respect to the probability of attaining the appropriate test power condition in operation, were intended.

The notice proposed to amend §§ 27.991 and 29.991 to require that each fuel pump must meet the endurance test prescribed in §§ 27.923 and 29.923, or equivalent. The main issue in this proposal concerns the possibility that the cited endurance tests may not be sufficient to fully substantiate fuel pumps. This proposal is therefore withdrawn for further study of the severity of endurance testing appropriate for fuel pumps.

The notice proposed to amend §§ 27.991(b) and 29.991(b) to allow a main fuel pump to be used as an emergency pump, as is allowed under § 25.991(b) for transport category airplanes. No adverse comments having been received, this amendment is drafted as proposed.

The notice proposed to delete provisions in §§ 27.991 and 29.991 that require the maintenance of safe fuel pressures, since such provisions duplicate fuel flow requirements in §§ 27.951, 27.955, 29.951, and 29.955. No adverse comments were received. With respect to § 29.991, this amendment is drafted as proposed. However, under § 27.991, the fuel pressure requirement is linked directly to the requirement for automatic or continuous operation, which should not be deleted. The proposal is therefore withdrawn with respect to Part 27.

The notice proposed to amend § 27.993 to eliminate the oversize fuel line requirement and corresponding test requirements of paragraphs (d) and (e), and to add requirements like those in § 29.993(c) (that flexible fuel connections subject to pressure or axial loadings must have a flexible hose assembly) and § 29.993(e) (that no flexible line that might be adversely affected by high temperatures may be used where excessive temperatures will exist during operation or after engine shutdown). No adverse comments were received with respect to the objectives of these proposals. However, one comment stated that no requirement for flexible hose assembly is necessary if the rule states that relative motion must not result in an unsafe condition. The FAA disagrees. The intent of § 29.993(c), and its proposed adoption under Part 27, is not to account for relative motion (which is covered elsewhere in the rule), but rather to alleviate the effects of pressure and axial loadings. These amendments are drafted as proposed.

The notice proposed to amend § 29.1091(d) to apply to reciprocating engines only. No adverse comments having been received, this amendment is drafted as proposed.

The notice proposed to amend § 29.997 to add a fuel strainer ice protection requirement similar to those in §§ 25.997(b) and 27.997(b). One comment suggested that the proposal be clarified to apply only to filter blockage and not to ice crystals downstream of the filter. Experience with §§ 25.997(b) and 27.997(b) does not indicate any need for such clarification. This amendment is drafted as proposed.

The notice proposed to amend §§ 27.1041 and 29.1041 to require adequate cooling "after engine shutdown" as well as under the conditions now specified in those sections. No adverse comments having been received with respect to the objective of the proposal, these amendments are drafted as proposed, with one minor change: In response to a similar proposal for Part 25 in a separate rule-making action, one comment noted that there may be abnormal engine shutdowns, such as an emergency shutdown from a high power setting, following which temperature limits may be exceeded. The FAA agreed in that case, and therefore narrowed the Part 25 amendment to cover only "normal" engine shutdowns. These amendments are similarly limited for the same reason.

The notice proposed to add, to §§ 27.1091 and 29.1091, turbine engine inlet protection requirements now prescribed for transport category airplanes in § 25.1091(d). One comment suggested limiting the requirement to flammable fluid lines furnished by the airframe manufacturer. The FAA disagrees. Adequate protection of the inlet from hazardous quantities of fuel leakage and from overflow from flammable fluid systems should be provided regardless of the leakage or overflow source within the flammable fluid systems. These amendments are drafted as proposed.

The notice proposed to add to § 29.1093 continuous maximum and intermittent icing condition provisions currently prescribed in § 27.1093. No adverse comments having been received with respect to the objective of the proposal, this amendment is drafted as proposed.

The notice proposed to add a new § 29.1121(h) requiring fuel drains that discharge clear of the rotorcraft if significant fuel traps exist. No adverse comments having been received, this amendment is drafted as proposed.

The notice proposed to amend §§ 27.1163 and 29.1163 to require torque limiting means on certain accessory drives in order to prevent the torque limits established by the manufacturer from being exceeded. One comment suggested language that would cover all "likely" effects of accessory malfunctions. The reason given was the prevention of possible misadministration of the rule as proposed. The exact nature of the misadministration anticipated by the commentator is not clear. However, the language suggested by the commentator would in any case exceed the scope of the notice by covering all possible likely effects of accessory malfunctions, not only the exceeding of torque limits. This amendment is limited to the objective expressed in the notice, which covered only the prevention of unsafe torque loads on accessory drives.

The notice proposed several changes to the designated fire zone provisions of § 29.1181. No adverse comments having been received with respect to the objectives of these proposals, these amendments are drafted substantially as proposed, with one editorial correction: Proposed § 29.1181(a)(8) is drafted as new § 29.1181(a)(7). Further, while the notice, in paragraph (c)(2), proposed that the combined combustor-turbine-tailpipe and compressor-accessory zones would be "a designated fire zone" under certain conditions, this conflicts with the proposal to designate the compressor and accessory sections as a fire zone and the combustor, turbine, and tailpipe sections as another fire zone. This proposed combination of zones is therefore withdrawn. In addition, the designated fire zone comprising the combustor, turbine, and tailpipe sections of turbine engine installations is drafted in a form consistent with the corresponding requirement in Part 25 (§ 25.1181(a)(7)). This limits the designated fire zone prescribed in § 29.1181(a)(7) to regions that contain lines or components carrying flammable fluids or gases. It is therefore unnecessary to refer to the absence of such lines or components in § 29.1181(b) as proposed in the notice. The notice also proposed to except combustor, turbine, and tailpipe sections from the requirement, in § 29.1181(b), to meet §§ 29.1183 through 29.1201 if those sections are isolated from the compressor and accessory sections by a firewall that meets § 29.1191. This proposed exception from §§ 29.1183 through 29.1201 would be too broad since it would except those regions from certain requirements that should apply regardless of whether or not a fire zone is involved, such as certain of the cowling and engine compartment covering requirements of § 29.1193. The proposal is therefore revised as follows: The combustor, turbine, and tailpipe sections designated as fire zones in § 29.1181 (a)(7) are drafted to exclude regions that are isolated from the compressor and accessory sections by a firewall meeting § 29.1191(a); § 29.1191(a) is amended to include the combustor, turbine, and tailpipe sections of turbine engine installations (as proposed in proposal 20 of the notice); finally, § 29.1203 is amended to require a fire detector system for the combustor, turbine, and tailpipe sections (regardless of whether such sections also qualify as designated fire zones). These amendments leave § 29.1181(b) unchanged.

The notice proposed to amend § 27.1185(b) to clearly limit it to reciprocating engines (and therefore remove any question as to whether turbine engines having thrust ratings comparable to reciprocating engines of 900 cubic inches displacement are also included) One comment objected, stating that the present requirements could not in any case be rationally applied to turbine engines by merely equating turbine thrust ratings with the prescribed displacements. The FAA agrees with this statement, but believes that the possibility that such an equation may be attempted is great enough to justify this clarifying amendment. This amendment is drafted as proposed by amending the applicability of paragraphs (a) and (b) to make them mutually exclusive on their face.

The notice proposed to amend §§ 27.1189, 29.1189, 29.1195, and 29.1203 to make it clear that exceptions contained in those sections for engines of certain cubic inch displacements may not be applied by analogy to turbine engines of roughly comparable thrust ratings. One comment objected, stating that the reasons for the exceptions are also valid for turbine engines of counterpart thrust parameters. The FAA agrees that extension of the exceptions to cover some turbine engines may be possible, after study, and should be proposed in a future notice of proposed rule making. However, until this is done, it is not appropriate to permit extension of the present exceptions, by analogy, to turbine engines. These amendments are drafted as proposed. Section 29.1195(a), second sentence, is also amended to conform more closely to the form of former § 7.484 (a)(3), on which it was based. No substantive change results since none was involved in the recodification. This amendment is therefore adopted without notice.

The notice proposed to amend §§ 27.1191(a) and 29.1191(a) to extend the term "engine," in the case of turbine engine installations, to cover the combustor, turbine, and tailpipe sections of those installations. No adverse comments having been received with respect to the objectives of this proposal, these amendments are drafted as proposed.

The notice proposed to amend § 29.-1193(e)(3) by deleting the words "in the engine power or accessory sections" and replacing them with the words "or burns out of any fire zone," in order to prevent turbine engine combustor burn-throughs from causing a fire to burn out of a fire zone. One comment objected, stating that the need for the changes cannot be found in the service experience of turbine engine powered rotorcraft. While specific helicopter experience bears out the commentator's statement, the FAA disagrees with the conclusion that no rule change is necessary. There is an established history of combustor can burn-through on turbine engines like those used in rotorcraft, although this history was obtained on airplanes. The fact that this history was obtained on airplanes does not lessen its validity, particularly since this history is based on service experience that is much longer than that yet available in the case of most rotorcraft. This amendment is therefore drafted as proposed. The notice also proposed to amend § 29.1193(c) to take account of the tendency of a fire that burns out of one zone to pass into the next zone "downstream." Because of the wide range of speeds available to helicopters, including hovering, the concept of what is "downstream" requires further study. This proposal is therefore withdrawn.

The notice proposed to add new §§ 27.1194 and 29.1194 to require fire protection of surfaces aft of, and adjacent to, engine compartments and designated fire zones. One comment stated that there is no need for proposed paragraph (b) of these sections in addition to the provisions of §§ 27.861 and 29.861. The FAA agrees. These proposed paragraphs are therefore withdrawn. The remainder of the proposal is drafted as proposed with one exception: Since there are no designated fire zones under Part 27, § 27.1194 uses the words "powerplant compartments" where the proposal referred to "engines compartments and designated fire zones." No substantive change results.

The notice proposed several amendments to the powerplant instrument requirements of § 29.1305. Comments objected to a proposed requirement for a fuel flow meter on the basis that the need for such an instrument should be determined in the operating environment rather than during type certification. The FAA agrees. This part of the proposal is therefore withdrawn. Except for this change and paragraphing changes, these amendments are drafted as proposed.

The notice proposed to add new §§ 27.1459 and 29.1459 to provide standards for equipment containing high energy rotors. These amendments have been renumbered as §§ 27.1461 and 29.1461. One comment stated that the proposed specific rules are unnecessary in addition to the general provisions of §§ 27.1309 and 29.1309. The FAA disagrees. Instances of fragmentation of air turbine starter wheels have occurred. These failures have in turn damaged components external to the starter. Reliance upon general rules to prevent recurrences of this kind of failure should not be continued. These amendments are therefore drafted as proposed.

The notice proposed several changes to the powerplant limitation provisions of § 29.1521 to accommodate turbine engines and achieve consistency with similar provisions in Part 25 where necessary for safe takeoff and continuous operation. The changes included a proposal to specify transmission oil temperature as a powerplant limitation. One comment objected, stating that the transmission oil temperature recorded during the endurance testing under § 29.923 should not become a limitation since it merely represents a temperature occurring under the test conditions. To the extent that only a recorded value is involved, the commentator would be correct. However, § 29.1011(e) requires rotor drive system oil cooling provisions to maintain the oil temperature at or below the "maximum established value" under specified conditions. Further § 29.1041(b) requires provisions to maintain the power transmission fluid temperature "within safe values" under specified conditions. Finally, with respect to the power transmission fluid cooling tests conducted under § 29.1043, paragraph (a) of that section requires (1) correction of recorded powerplant temperatures to account for changing test conditions, and (2) assurance that no corrected temperature will exceed "established limits." It is thus clear that, with respect to power transmission fluid temperatures, the establishing of a safe limit rather than the mere recording of values is involved under the present regulations. This comment cannot, therefore, be accepted. These amendments are drafted as proposed.

Nautical measure. The notice proposed to amend Parts 27 and 29 by changing all references to "miles" and "miles per hour" to "nautical miles" and "knots," respectively, wherever the former are used. No adverse comments were received with respect to the objectives of this proposal. These amendments are therefore drafted as proposed, using the following criteria: (1) In response to one comment, conversions from miles per hour to knots are rounded off to whole units to avoid fractions of a knot, since accurate fractional knot measurement is not necessary under the present rules and is not required to be within the capability of required airspeed indicating systems; (2) current requirements specifying extremely low airspeed values, such as 5 or 10 miles per hour, are not changed numerically (such as to 4 or 9 knots, respectively) since the substantive difference in these cases is approximately 1 mile per hour, which is not practically significant. Sections 27.1399 and 29.1399, which require that each riding light required for water operations must show a white light for at least "two miles", have been amended to read "two nautical miles". This change is substantively insignificant within the conditions of visibility under which illumination is measured. No increase in burden results. One comment requested that no change be made with respect to allowing the use of airspeed indicators calibrated to read in terms of miles per hour. This comment is accepted. Nothing contained in these amendments requires the calibration of the airspeed indicator to read in terms of knots. Finally, it should be noted that the change to nautical units in § 29.1323 is combined with substantive changes based on Flight Proposal 19.

In consideration of the foregoing, Parts 1, 27, and 29 of the Federal Aviation Regulations are amended, effective February 25, 1968, as hereinafter set forth.
(Secs. 313(a), 601, 603 Federal Aviation Act of 1958; 49 U.S.C. 1354(a), 1421, 1423)

Amendment 27–3

Critical Rotorcraft Components

Adopted: September 10, 1968 **Effective: October 17, 1968**

(Published in 33 F.R. 14104 September 18, 1968)

The purpose of these amendments to Parts 21, 27, 29, 43, 45, 91 and 127 of the Federal Aviation Regulations is to (1) permit rotorcraft manufacturers to adopt fail-safe fatigue design practices for certain portions of the flight structure on condition that related fatigue crack detection procedures and inspection intervals are approved under the required fatigue evaluation as part of the type design and placed in a separate section of the rotorcraft maintenance manual, (2) require that the replacement times of certain critical components be similarly approved and placed in the separate section of the maintenance manual, (3) require that this section of the manual be referenced by placard in the rotorcraft, and (4) specifically require operators and maintenance personnel to comply with this section of the maintenance manual. The amendments will also require manufacturers to make certain revisions of the rotorcraft maintenance manual available to operators and require identification of certain critical components.

These amendments are based on a Notice of Proposed Rule Making (Notice No. 67–44) published in the Federal Register on October 11, 1967 (32 F.R. 14106).

A number of comments were received in response to Notice No. 67–44, most of which were in agreement with the proposal. The more pertinent of the comments that raised questions together with the changes in the proposal resulting therefrom are discussed hereinafter.

In view of the new sections that were proposed, one commentator suggested that existing § § 27.307(a) and 29.307(a) be clarified by indicating that the structural analysis used in connection with proof of structure, be permitted to be either static or fatigue. The FAA agrees that such a change would more fully express the intent of the rule yet not imply a change in past practice in which fatigue evaluation has generally involved testing. The sections have been amended accordingly.

As previously stated in the preamble of the Notice, the standards of new § § 27.571, 29.571, 27.1529 and 25.1529 are intended to preserve the design objectives stated in Notice 65–42, Airframe Proposal 8, except for clarifying changes.

One commentator stated that use of the word "component" in the proposed § § 27.571(a) and 29.571(a) could be interpreted as meaning that the entire fuselage, for example, and most of its elements are critical so that a formal fatigue evaluation would be required to be performed on each frame, stringer, panel, or combination. However, since not all parts of a flight structure, such as the fuselage, are likely to be critical in fatigue, it was suggested that the requirement be clarified to call for evaluation only of those considered critical. The FAA is in substantial agreement for it was not intended to require detailed evaluation of a portion of the structure for which no significant fatigue loading exists. The paragraph has been amended, therefore, to delete the word "component" and indicate that it is the critical portion of the flight structure that must be identified and evaluated. A further recommendation that the paragraph be amended to be applicable to failures which "would" be catastrophic rather than those which "could" be catastrophic has been rejected since this would imply that doubtful areas need not be included in the fatigue evaluation. In connection with the requirement for fatigue evaluation of flight structure, it was suggested that the intent be clarified so as not to extend the fatigue evaluation to non-critical parts. While the FAA agrees with the objective of this comment, it is believed that the revisions to § 27.571(a) and § 29.571(a) discussed above sufficiently delineate the applicability without introducing the new term "noncritical".

As they were proposed, § § 27.571(a)(3)(i) and 29.571(a)(3)(i) indicated that loads and stresses need be subjected to inflight measurement only throughout the range expected in operation where such range is less than the range of design limitations stated in § § 27.309 and 29.309. It is apparent that such a generally stated alternative is at variance with other requirements inasmuch as design weight, rpm, airspeeds, and c.g. limits are attainable without extreme maneuvers and are, in general, explored in other phases of the flight test program. With maneuvering load factors, the situation is otherwise, however, and since it would be unrealistic in connection with fatigue evaluation to require measurement of loads and stresses at the limit maneuvering load factors, the alternative of using operational rather than design limits would there be applicable. To remove any ambiguity with reference to weight, rpm, airspeed, and c.g. limits, § § 27.571(a)(3)(i) and 29.571(a)(3)(i) have been reworded to make it clear that it is for only maneuvering load factors that inflight measurements may be made with reference to values expected in operation.

The FAA agrees with a comment that the intent of § § 27.571(d)(2) and 29.571(d)(2) is to distinguish the lesser of the limit and maximum attainable loads rather than designate one as being applicable. The parenthetical expression in the two sections has been amended to state "whichever is less".

Pointing out that some procedures are so simple and well known that actual demonstration should not be required, one commentator objected to the requirement that all procedures in the "Airworthiness Limitations" section of the Rotorcraft Maintenance Manual be shown to be practicable. Since the need for an actual demonstration should be determined on an individual basis, the requirement for a showing has been eliminated in § § 27.1529(a)(2)(ii) and 29.1529(a)(2)(ii).

One of the comments received in response to the Notice requested that the FAA specifically countermand the "administrative procedures" specified in the preamble. In this connection, the commentator referred to the preamble discussions in which the FAA indicated that if safety requires that the airworthiness limitations in the Rotorcraft Maintenance Manual must be made more severe, appropriate changes to the manual would be made by airworthiness directives. While the comment objected to the general use of airworthiness directives, it did indicate acceptance of telegraphic airworthiness directives for use in this regard.

As pointed out in the preamble to Notice 67-44, the inspection intervals, replacement times and related procedures set forth in the "Airworthiness Limitations" section of the Rotorcraft Maintenance Manual are limitations on the original approval of the type design. Thus, any changes to these limitations are, in effect, changes to the type design. In recognition of this fact, airworthiness directives have long been used by the FAA to prescribe changes to the service life limits for a product. However, it should be made clear that since the replacement times, inspection intervals, etc., would now be placed in a maintenance manual, the manufacturer's changes to the manual and subsequent dissemination to all operators would serve the purpose originally served by airworthiness directives. However, as the FAA pointed out in the preamble discussions, in those instances where a safety necessity exists, the airworthiness directive is the means by which the FAA can assure that the operators have the revised limitations. Moreover, an airworthiness directive would also be required in those instances in which a manufacturer failed to issue revisions to the limitations which the FAA considered necessary in the interest of safety. Only in the latter instance would the FAA make changes to the manual by airworthiness directive. As the commentator correctly noted, approved revisions to the airworthiness limitations section of the maintenance manual have had the same legal effect as the original limitations and the issuance of airworthiness directives with respect to such limitations would not be inconsistent with that fact.

The FAA agrees with one final suggestion that service experience may be used in certain instances in a resubstantiation of the flight structure, as, for example, for a relaxation of a replacement time or inspection interval in the "Airworthiness Limitations" section of a Rotorcraft Maintenance Manual. It must be recognized, of course, that time extensions for parts, the failure of which would be catastrophic, cannot be based solely on failure rates or absence of failures in service. However, it is intended to permit appropriate use of service experience in reevaluating flight structure in accordance with § § 27.571 and 29.571. In this connection, laboratory tests might be made on parts that have been used in service to determine whether the original assumptions were overly conservative.

Interested persons have been afforded an opportunity to participate in the making of this amendment, and due consideration has been given to all matter presented.

In consideration of the foregoing, Parts 21, 27, 29, 43, 45, 91, and 127 of the Federal Aviation Regulations are amended effective October 17, 1968.

This amendment is made under the Authority of sections 313(a), 601, 603, 604, and 605 of the Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421, 1423, 1424 and 1425).

Amendment 27-4

Dual Locking Devices

Adopted: September 20, 1968 **Effective: October 27, 1968**

(Published in 33 F.R. 14533, September 27, 1968)

The purpose of these amendments is to require two separate locking devices for certain removable fasteners on rotorcraft.

These amendments are based on a Notice of Proposed Rule Making (32 F.R. 15676, Nov. 14, 1967) circulated as Notice No. 67-49 dated November 7, 1967.

Numerous comments were received in response to Notice 67-49 and changes have been made to the proposal based upon these comments. The comments received and the changes in the proposal resulting therefrom are discussed below.

One of the comments indicated that since the proposal listed only externally threaded fasteners, it could imply that an internally threaded fastener such as a "nut" need not have a locking device. There was no intent to exclude any removable fastener under the proposal and the final rule has been revised to specifically include nuts.

Another comment recommended that rather than use the term "safe operation", the test under the regulation should be whether a landing can be made without damage to the helicopter but to accept damage to the landing gear components that are designed to yield during hard landings. The FAA, however, does not agree that the sole test for dual locking devices should be whether the helicopter can be safely landed following the loss of a removable fastener. To the contrary, safety dictates that the requirement for dual locking devices must take into consideration the need for continued safe operation of the helicopter following the loss of a fastener in order to afford the pilot an opportunity to locate a suitable landing area. For this reason, the regulation has not been changed as recommended. On the other hand, it should be pointed out that any design feature, structural or otherwise, approved in the type design may be taken into account in showing compliance with the regulation. Thus, a landing resulting in damage to landing gears that are designed to yield during a hard landing would not, by itself, be considered as an unsafe operation.

In adition to the foregoing, the FAA does not agree with the suggestion that the regulation should be limited to fasteners in the control system of rotorcraft. The FAA considers that any fastener, the loss of which could preclude the continued safe flight and landing of rotorcraft, should be covered by this regulation. Moreover, contrary to a recommendation by one of the commentators, the FAA has retained the requirement that the fastener and its locking device may not be adversely affected by the environmental conditions associated with the particular installation. Service experience has shown that the locking capability of certain types of fasteners can be adversely affected by environmental conditions associated with rotorcraft.

One comment recommended that at least one of the prescribed locking means should require shearing or rupture prior to failure of the fasteners. Another comment recommended that one of the locking devices should be a friction type. The FAA does not agree with these comments insofar as fasteners other than bolts subject to rotation in flight are concerned. For such fasteners, the FAA does not consider it necessary that the locking devices be of a different type as long as they are separate devices. Thus, it would be satisfactory to have either two separate friction type locking devices or two separate non-friction locking devices on any such fastener.

With respect to bolts that are subject to rotation in flight, however, the FAA agrees that one of the locking devices must be of a non-friction type. While the notice proposed to remove the prohibition against the use of self-locking nuts on bolts subject to rotation in flight, this was based on the assumption that under the new requirement for two separate locking devices, such a prohibition would be unnecessary. However, after reconsideration, the FAA is aware that the new requirement could be met by the installation of two friction type (self-locking) locking devices and this would not provide the necessary level of safety. Therefore, while the absolute prohibition against the use of self-locking nuts on bolts subject to rotation in flight has been removed as proposed, the proposal has been modified to prohibit the use of two self-locking nuts on bolts subject to rotation in flight.

Interested persons have been afforded an opportunity to participate in the making of these amendments. All relevant material submitted has been fully considered.

In consideration of the foregoing, Parts 27 and 29 of the Federal Aviation Regulations (14 CFR Parts 27 and 29) are amended effective October 27, 1968.

These amendments are issued under the authority of section 313(a), 601 and 603 of the Federal Aviation Act of 1958. (49 USC 1354, 1421, and 1423).

Amendment 27–5

Fire Detectors and Engine Power Response

Adopted: March 16, 1971 **Effective: April 23, 1971**

(Published in 36 F.R. 5490, March 24, 1971)

The purpose of these amendments is to expand the design and installation requirements for fire detector devices in transport category airplanes, to require a fire detector system in normal category rotorcraft, and to establish more specific requirements concerning engine response to throttle control movement under various load conditions.

These amendments are based on Notice 69–7, issued March 8, 1969, (34 F.R. 5020). Numerous comments were received in response to Notice 69–7 and changes have been made in the proposal based thereon. These changes are discussed hereinafter.

One of the comments stated that fire detectors should be capable of monitoring the worst fire foreseeable and suggested that this language be incorporated into § 25.1203. The FAA does not consider that such a change is necessary. The regulations now require that fire detectors be installed in each designated fire zone and in the combustion, turbine, and tailpipe sections in sufficient numbers and locations to ensure prompt detection of a fire. This regulation is not limited to any particular type of fire, but applies to all fires in the designated areas. It would, therefore, include the worst fire foreseeable. The commentator also requested that the regulation be changed to prevent the fire detectors from being rendered inoperative by a type of fire, such as blowtorching. The FAA is aware that there have been instances in which detectors were rendered inoperable due to blowtorching. However, this has occurred infrequently. Under this regulation, the detector system must still function in the event the sensor or wiring is severed at one point, unless there is a means to warn the crew of the severing, whether or not the severing results from "blowtorching". Moreover, if the system does become inoperative due to a short circuit in the system, a means is required to alert the crew to this condition. The FAA, therefore, believes that the matters raised by the commentator are already adequately covered and that the suggested changes to the proposal are unnecessary.

One commentator suggested that fire detector systems should provide both visual and aural fire warning, contending that visual lights are ineffective in sunlight and that taller pilots are unable to see some warning lights from the normal sitting position. The commentator also urged that all transport category aircraft be required to have installed the newer and more reliable types of fire detection equipment as they become available, and observed that some aircraft presently in service do not provide fire extinguishing for certain combustion heaters which burn JP-1 fuel and are located in the tail compartment, inaccessible to the crew in flight. With respect to the first comment, the FAA does not believe it is necessary to require both visual and aural fire warning indicators. So long as the type of warning means selected by the manufacturer provides prompt and effective warning of fire to the crew, either visual or aural means may be used. If both visual and aural means are needed to provide effective fire warning, then both means would have to be used. Further evaluation of the proposal has revealed that the term "alert" as used in the proposed § 25.1203(b)(3) may cause some confusion. The intent of the requirement was to provide a warning for the crew and this term is consistently used throughout the regulations. Therefore, the regulation has been revised to require a means to warn the crew in the event that a short circuit occurs. With regard to the second comment, the FAA does not believe it is either necessary or feasible to require that the newer fire detection equipment be installed in the older transport category airplanes. In many instances the installation of the newer detection systems in the older airplanes would be extremely burdensome, if not impossible. Moreover, the FAA is not aware that fire detection systems on older aircraft are inadequate or that they need to be replaced with the newer equipment. In any event, if an unsafe condition were found involving the fire detector system of any airplane now in operation, appropriate action, including an airworthiness directive, would be taken to correct that condition. Regarding the commentator's observation concerning JP-1 combustion heaters, it should be noted that the current airworthiness regulations (§ 25.859) do not require fire protection for all combustion heaters. Section 25.859 requires that combustion heater fire protection must be provided for the region surrounding the heater only if this region contains any flammable fluid system components (excluding the heater fuel system) that could be damaged by heater malfunctioning or could allow flammable fluids or vapors to reach the heater in case of leakage, or if the heater fuel system has fittings that, if they leaked, would allow fuel or vapors to enter this region. Thus, in any region surrounding a heater where the conditions covered in the regulation do not exist, fire protection would not be required. This rule would apply to the situation referred to by the commentator. A change in the current requirements is not considered necessary in the interest of safety.

After further evaluation in the light of various comments received, the FAA has determined that the proposed requirement that a fire detector remain in an operable condition in the event it is severed at one point is unnecessarily restrictive. The FAA has determined that it is not necessary in the interest of safety to require that a fire detector system remain operable after it has been severed at one point or, for that matter, after a short circuit, if there is a means to warn the crew that the system has been severed or that there has been a short circuit. The proposal has, therefore, been changed to require that there be a means to warn the crew in the event that the fire detector system does not continue to function as a satisfactory detection system after the sensor or the associated wiring has been severed at one point or after there has been a short circuit in the sensor or associated wiring.

Another commentator observed that single spot detectors would not meet the proposed requirements since they do not remain operable if severed at any one point, and stated further that the regulation would dictate the use of dual loop detector systems. However, in view of the change to the proposal discussed in the preceding paragraph, single spot detectors could be used if the fire detection system provided the required warning to the crew.

One commentator suggested that the term "fire detector system" be defined to include the sensors, control means, indicating panel, and associated wiring. The commentator also suggested that § 25.1203(b)(1) be changed to refer to the severing of sensors and associated interconnecting means. However, the FAA's recent evaluation of fire detector system failures has shown that only the fire detector sensors and associated wiring located in designated fire zones need to be protected from severing and that failures due to shorts are most likely to occur in designated fire zones. The proposal has, therefore, been revised to refer only to the "sensor or associated wiring within a designated fire zone".

The FAA has also determined on the basis of comments received, that the phrase "remain in an operable condition" does not accurately convey the intent of the proposal. Safety requires that the crew must be warned in the event that the fire detecting sensor or associated wiring in any designated fire zone is severed unless the system "continues to function as a satisfactory detection system." The proposal has been changed accordingly.

It was proposed to require a means to alert the pilot in the event of a short circuit in the detector system. However, after further consideration the FAA believes that it is not appropriate in the interest of safety to restrict the warning to the pilot and the regulation now provides for a means to warn the crew in the event of a short circuit.

Two of the comments pointed out that the proposal would require an alert in the event of a short circuit even though in a given case the short circuit might not impair the performance of the fire detector system. The FAA agrees that the proposal is not clear in that respect, and that it is not necessary in the interest of safety to require that the system provide an alert to the crew of any short circuit which does not render the detector system incapable of detecting a fire. The proposal has been changed accordingly.

Several comments objected to the proposed requirement that the fire detector be constructed or protected so that when it is in the configuration for installation it would withstand mechanical damage that might occur as a result of routine maintenance performed on the powerplant. The comments indicated difficulty with the scope of routine maintenance and with the requirement that the detector withstand mechanical damage. However, in view of the changes being made to the proposal permitting a warning to the crew in the event that a fire detector sensor or associated wiring is severed at one point, the FAA considers that the subject requirement is no longer necessary. Section 25.1203(g) as proposed in Notice 69–7, has been revised accordingly.

Some commentators contended that the present fire detector TSO (TSO-C11d) should be changed so that the required response time test will allow more than the presently prescribed 5 seconds for high alarm temperature sensors. One of the commentators also suggested that TSO-C11d allow for the effect of airframe structure on response time, and that a pre-flight check be required in order to verify the performance of the detector system if the system is not demonstrated to be unaffected by damage or age. With respect to the first comment, the FAA believes that the 5-second response time now permitted by TSO-C11d is the maximum that can be allowed consistent with safety. However, the TSO does provide for a higher initial temperature for high alarm temperature sensor tests, provided those sensors are used only in the corresponding high alarm temperature installation. Regarding the effect of airframe structure on detector response time, the TSO requirements pertain to the performance of the detectors separate from the many types of aircraft in which they may be installed. However, with respect to the commentator's suggestion, the FAA does not agree that the detector response time in the TSO should be increased to take into consideration the effect of airframe structure. Safety dictates that the TSO detector response time must be met with the detectors in the installed configuration and the proposal is unchanged in this respect. In regard to the last comment, while § 25.1203(d) presently requires that there must be a means to check the functioning of each fire detector circuit in flight, service experience has not indicated that there is a need to require a preflight check to verify performance of the detector system.

There was also a comment which recommended that the system remain in an operable condition or, in the alternative, that there be a means to warn the crew in the event of a break or short in a fire detector element. As previously pointed out, the proposal has been changed to provide for a crew warning unless the system continues to function as a satisfactory detection system after the severing or short circuit.

Upon further review of the proposed amendments to § 25.1203, and in view of some of the above comments, the arrangement of the section is being changed slightly in the interest of clarity. Therefore, that part of the proposed § 25.1203(g) requiring that fire detectors withstand vibration, inertia, and other loads is being incorporated into § 25.1203(b), where it is logically associated with the requirements concerning severing and shorting of the fire detectors.

In regard to the proposed new § 27.1195, one comment was received which urged that the proposed regulation be omitted from the final amendment. The commentator contended that the lower rate of engine failures, including engine fires, for turbine engine powered rotorcraft as compared to the rate for reciprocating engine powered rotorcraft shows that there is no need for the proposed requirement for fire detectors. The commentator also stated that the provisions in Part 27 requiring that the flammable fluid line and fitting in any area subject to engine fire conditions must be located or shielded to prevent fluid leakage on surfaces hot enough to ignite the fluid, provide a level of safety equivalent to that provided by the present § 29.1203, which requires fire detectors in transport category rotorcraft. Further, the commentator questioned whether the greater fuel load of turbine engine powered rotorcraft was a valid factor in requiring fire detectors, and maintained that engine fires can be detected by the pilot via normal engine instruments. The FAA does not agree that the proposed § 27.1195 is unnecessary. The FAA is not aware that the rate of engine failures, including fires, is lower for turbine engine powered rotorcraft and the commentator has submitted no data to substantiate this claim. In any event, the FAA does not agree that the present § 27.1183(a)(3) provides a level of safety equivalent to that provided by § 29.1203. Although § 27.1183(a)(3) does prescribe standards of safety for flammable fluid line and fitting leakage which are not now provided for Transport Category Rotorcraft, Part 29 is currently being amended in conjunction with other airworthiness Parts and the FAA is updating the standards for flammable fluid lines, fittings, and other components. Further, the additional hot surface area of turbine engines poses a hazardous source for the ignition of leaking flammable fluids on turbine engine powered rotorcraft. It should be noted that § 27.1195 will appy only to turbine engine powered rotorcraft. The FAA does not agree that engine fires on Part 27 rotorcraft are detectable by the pilot through normal engine instruments and the commentator has submitted no data in support of this contention. Finally, the FAA notes that turbine engine powered rotorcraft have higher altitude performance capability than do reciprocating engine powered rotorcraft. The time required for an emergency descent and landing following an engine fire may thus be appreciably greater for turbine engine powered rotorcraft and could exceed the 5-minute period provided by § 27.861 for the protection of the rotorcraft structure, controls, rotor mechanism, and other essential parts in the event of powerplant fires. The immediate detection of turbine engine fires by means of a fire detector system is therefore required in the interest of safety.

A number of comments were received in regard to the proposed §§ 33.73 and 33.89. Two commentators questioned whether the maximum rated power or thrust specified in § 33.73 would include the augmented thrust resulting from after-burning. The intention of the proposal was that the takeoff power or thrust rating used in showing compliance with that section be a rating selected by the applicant for the certification of its engine. However, if the applicant elects to use augmented thrust in establishing the rated thrust of the engine for certification, the augmented thrust need not be used in showing compliance with § 33.73. The manufacturer will have the option of using either augmented thrust or unaugmented thrust in demonstrating compliance with § 33.73, and proposed § 33.73(b) has been revised to make this clear. In addition, after further study it has been determined that the word "maximum" as used in the proposed § 33.73 is not necessary and may cause confusion. The definitions in Part 1 of the FAR's refer to "rated takeoff power" and "rated takeoff thrust", and in the interest of consistency, the phrases "maximum rated power or thrust" and "maximum rated takeoff power or thrust" in § 33.73 have been changed to "rated takeoff power" and "rated takeoff thrust".

Various changes to the wording of proposed § 33.73(b) were recommended to make provision for the differences in power management of the primary propulsion systems of fixed wing and rotary wing aircraft, and to improve compatibility between Part 33 requirements and the landing climb requirements of Part 25. The FAA does not agree that the suggested changes are necessary. The language of proposed § 33.76(b) was selected to represent the minimum power setting to be used in the certification of all engines. Furthermore, § 33.73(b) is a design requirement for a specific engine thrust response capability without relation to the many power management systems that may be used. Insofar as compability of the new regulation with Part 25 is concerned, the FAA sees no conflict. Section 25.119 allows 8 seconds between the movement of the power lever from minimum flight idle to maximum takeoff position and demonstration of the required minimum climb gradient capability. The extra 3 seconds provided by § 25.119 over the 5 seconds provided by § 33.73(b) should be adequate to provide for any engine power losses due to engine installation, accessory loads, and air bleed. In any event, it is the airframe manufacturer's responsibility to select an engine having adequate thrust response characteristics to match the expected performance characteristics of the airplane and to comply with the regulations, including § 25.119. The intent of § 33.73(b) is to establish minimum engine thrust response characteristics, and not to deal with airplane performance requirements.

Several comments were received in response to the proposed § 33.89. One commentator suggested that § 33.89(c) be reworded to incorporate the more precise definition of idle power and the 5 second response time provided in § 33.73(b). The agency does not agree with the suggested change. Section 33.73(b) prescribes design requirements, whereas § 33.89 is concerned with operational test requirements. From the standpoint of engine operation, the precise idle power setting used to demonstrate design power or thrust response time is not appropriate, since the variables introduced during the operational test may cause the power or thrust produced by the engine when the power lever is at the specified idle power setting to be somewhat different from the design idle power or thrust. Requiring this test to be run with prescribed power lever positions will result in more realistic test times. The commentator also suggested that a new paragraph (d) be added to include engine operation with variable geometry inlet and exhaust nozzles, and with thrust augmentation. However, this comment is beyond the scope of Notice 69-7 and will be considered in future revisions to Part 33. Another commentator suggested that the requirements of § 33.89(c) be deleted, except for subparagraph (c)(1), and be transferred to Subpart E of Part 33 as design and construction standards since the test facilities necessary to make the determinations required under § 33.89 are not widely available. The FAA does not agree that the requirements of § 33.89 should be transferred to Subpart E. However, the FAA is aware that the necessary test facilities for power extraction may not be available, and analytical means could be used in lieu of the test prescribed for power extraction by §§ 33.89(c)(2) and 33.89(c)(3). Therefore, a new paragraph (d) has been added to permit the use of analytical means for the tests prescribed by §§ 33.89(c)(2) and 33.89(c)(3) for power extraction if necessary test facilities are not available.

Interested persons have been given an opportunity to participate in the making of these amendments. All relevant material submitted has been fully considered.

In consideration of the foregoing, Parts 25, 27, and 33 of the Federal Aviation Regulations are amended, effective April 23, 1971.

These amendments are made under the authority of Sections 313(a), 601, and 603 of the Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421, and 1423), and Section 6(c) of the Department of Transportation Act (49 U.S.C. 1655(c)).

Amendment 27-6

Anticollision Light Standards

Adopted: July 1, 1971 **Effective: August 11, 1971**

(Published in 36 F.R. 12970, July 10, 1971)

The purpose of these amendments is to (1) permit the use of either aviation red or aviation white anticollision light systems; (2) expand the chromaticity-coordinate range for aviation white; (3) increase the minimum effective intensities for anticollision lights installed on all aircraft to be type certificated after the effective date of these amendments; and (4) require that within one year after the effective date of these amendments all powered civil aircraft with standard airworthiness certificates have an approved anticollision light system for night flight.

These amendments are based on a notice of proposed rule making (Notice 70-21) published in the Federal Register on June 4, 1970 (35 F.R. 8665). Numerous comments were received in response to the Notice and except to the extent that a comment merely repeated issues which were discussed in detail and properly disposed of in the Notice, the FAA's disposition of those comments are set forth hereinafter.

Several comments objected to the requirement that all aircraft flying at night must be fitted with an approved anticollision light. One commentator pointed out that certain operators of small aircraft may fly for a few minutes after dark but only to reach a destination and that such operators should not be burdened with an expensive anticollision light requirement. Another commentator took a similar position with respect to aircraft that are operated at night only in local areas or only in an emergency. The FAA does not agree. With proper flight planning, flight after dark can usually be avoided without inconvenience. Moreover, any aircraft operating at night without an approved anticollision light constitutes a hazard regardless of whether it is being operated in a local area or in an emergency.

One commentator indicated that the FAA may have underestimated the problems associated with removal of the red filter on the anticollision light on existing aircraft. The commentator pointed out that it may be impossible to meet the current field-of-coverage requirements because of the need to mask the unfiltered light to eliminate back-scatter. While the FAA recognizes this problem, it should be noted that it was not proposed to require anyone to remove the red filters on existing aircraft. Moreover, if an operator elected to do so, he would not be required to meet the new intensity requirements. Furthermore, he could relocate the light to minimize the back-scatter problem.

There were numerous comments received in response to Notice 70-21 which recommended changes to the regulations in addition to those proposed in the Notice. In this connection, it was recommended that the current field-of-coverage requirements be extended; that the existing flash-frequency requirements be modernized; that exterior minimum intensity requirements be increased beyond the values proposed in the Notice; that a red anticollision light be required for nighttime use and a white anticollision light be required for daytime use; and that the operating rule in Part 91 also cover aircraft other than powered civil aircraft with standard airworthiness certificates. While some of these recommendations may have merit, they are beyond the scope of Notice 70-21. However, the FAA is now in the process of investigating and evaluating these recommendations to determine which merit further rule-making action.

One commentator suggested that final action on Notice 70-21 should be deferred until the current FAA/NASA research on aircraft exterior lighting is completed. The FAA does not agree. The changes to the anticollision light requirements proposed in Notice 70-21 are very limited in scope and they are not being dealt with directly in the referenced research. The additional rulemaking that may be generated by the FAA/NASA research would be concerned with the entire area of aircraft exterior lighting and no useful purpose would be served in further delaying the proposed changes.

Several commentators expressed the view that the display of white condenser-discharge anticollision lights significantly reduces the frequency of bird strikes in flight. One respondent submitted statistical data in support of its position and urged that the display of white condenser-discharge lights be made mandatory. The FAA does not agree with these comments. After a thorough review of the data presented, the FAA does not believe that a significant correlation between display of white condenser-discharge lights and frequency of bird strikes has been shown. However, the FAA is continuing its investigation in this area and if further studies reveal that a correlation does exist, it will be the subject of future rule-making action.

Various comments pointed out that while the notice proposed to require an "approved" anticollision light system, it did not specify the standards for such approval. This appears to be a problem only with respect to anticollision light systems that would have to be installed on aircraft type certificated under airworthiness standards which did not incorporate anticollision light standards. For large aircraft and for certain small aircraft, the operation rules have long required anticollision lights and the airworthiness regulations have long contained standards for such lights. Thus, lights meeting the applicable airworthiness standards are approved lights. In addition, numerous airplanes have, in the past, had anticollision light systems installed voluntarily. All of these systems were approved by the FAA and they continue to be approved. The question as to the identification of approved anticollision light systems arises with respect to the installation of anticollision lights required by this amendment to be installed on aircraft which were certificated under airworthiness standards that did not contain standards for anticollision lights. The FAA is aware that in most instances, the modifications to the older aircraft that would be necessary in order for the anticollision lights to meet the higher intensities proposed in Notice 70-21 would be extensive and may, in certain instances, be prohibitive. This was recognized in the Notice and it was not intended that the older aircraft should be required to meet the higher intensities set forth in this amendment. Therefore, the proposal has been revised to make it clear that for the initial installation of anticollision lights on the older aircraft (those for which type certificates were applied for or issued prior to the effective date of this amendment), the anticollision lights would only need to meet the anticollision light standards in Parts 23, 25, 27, or 29, as applicable, effective immediately prior to the effective date of the amendments contained herein.

Another comment expressed an objection to the proposed increase in the intensity level of anticollision light systems for future aircraft on the grounds that for small aircraft using red anticollision lights, power requirements would be unreasonable, service life short and reliability low, and that for small aircraft using the white anticollision lights, it would not be possible to shield them for purposes of back-scatter without a reduction in the required field-of-coverage. The FAA is aware that for red anticollision lights more electrical power would be needed to meet the new requirements than has been provided in the past. However, the FAA believes that this additional power capacity can be provided on future aircraft at reasonable cost, without incurring a low-service-life or low-reliability penalty. Moreover, a manufacturer would now have the option of installing a white anticollision light, thereby eliminating the power problem. The back-scatter problems referred to by the commentator can be solved without diminishing the field-of-coverage by installing a system consisting of three lights, one at each wing-tip and one on the tail.

Finally, one commentator urged the FAA to specify, as part of the revision to the intensity standards for anticollision lights, a minimum infra-red signal content for use with PWI systems now under development. This matter was discussed in some detail in Notice 70-21 and the FAA maintains its view that it would be premature to require a minimum infra-red signal content until current evaluations by the FAA of the PWI system concept on civil aircraft have been completed. This does not, however, prohibit the incorporation of infra-red signal content in any anticollision light system.

In consideration of the foregoing, Parts 23, 25, 27, 29, and 91 of the Federal Aviation Regulations are amended, effective August 11, 1971.

These amendments are issued under the authority of sections 313(a), 601, 603, and 604 (49 U.S.C. 1354, 1421, 1423, and 1424), and of section 6(c) of the Department of Transportation Act (49 U.S.C. 1655(c)).

Amendment 27-7

Position Light System Dihedral Angles

Adopted: October 28, 1971 **Effective: November 5, 1971**

(Published in 36 F.R. 21278, November 5, 1971)

The purpose of these amendments to §§ 23.1387, 25.1387, 27.1387, and 29.1387 of the Federal Aviation Regulations is to permit the installation of rear position lights with minor obstructions in the field of coverage.

Sections 23.1387, 25.1387, 27.1387, and 29.1387 presently require, in part, that the rear position light show unbroken light within a dihedral angle formed by two intersecting vertical planes making angles of 70° to the right and left, respectively, of a vertical plane passing through the longitudinal axis. Other related provisions of the regulations require that the rear position light be mounted as far aft as practicable.

In certain aircraft designs incorporating swept vertical tail surfaces, the obstructed visibility requirements may be met only by locating the rear position light on the trailing edge of the rudder. Because this location may cause a number of problems, including complex electrical installation and adverse rudder flutter characteristics, some manufacturers consider the aftmost tip of the fuselage to be a more suitable location. Thus, while the rudder position may be further aft, the fuselage location is as aft as is practicable. At the same time, however, the fuselage location does not comply with the obstructed visibility requirements where parts of the rudder and vertical stabilizer of a swept tail project into space required to be unobstructed.

For aircraft having this problem, the obstruction resulting from use of the aft fuselage location would, nevertheless, be relatively small because of the thinnes of the vertical stabilizer and rudder. Moreover, the obstruction occurs at a high angle above the longitudinal axis of the aircraft so that except for the near-zenith position, the rear position light shows unbroken light.

Related requirements for position lights allow diminishing light intensity with increasing angle above or below the horizontal. Thus, for angles 40° and more above and below the horizontal plane, the position light intensity need be only 5 percent of the light intensity in the horizontal plane. This provision thus recognizes that the significance of a position light decreases as zenith is approached.

A provision similar to that being here established for the rear position light already exists with respect to the anticollison light. In this connection, minor visibility obstructions permitted in the rearward direction in the field of coverage of the anticollision light have been determined not to be detrimental to safety.

In light of the foregoing, obstructions within the dihedral angle in which the rear position light must show, which do not exceed 0.04 steradians in coverage and which occur within 30° of a vertical line through the rear position light, would not adversely affect safety. In addition, these amendments permitting minor obstructions in the field of coverage of rear position lights are consistent with the provisions of §§ 23.1385(c), 25.1385(c), 27.1385(c), and 29.1385(c) which recognize practicable considerations in the location of rear position lights.

For the foregoing reasons and since these amendments relieve a restriction and impose no additional burden on any person, I find that notice and public procedure thereon are unnecessary and that good cause exists for making them effective on less than 30 days notice.

In consideration of the foregoing, Parts 23, 25, 27, and 29 of the Federal Aviation Regulations are amended as follows, effective November 5, 1971.

These amendments are made under the authority of sections 313(a), 601, and 603 of the Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421 ,and 1423), and of section 6(c) of the Department of Transportation Act (49 U.S.C. 1655(c)).

Amendment 27-8

Airplane and Rotorcraft Manuals, Markings, and Placards

Adopted: September 19, 1972 **Effective: October 23, 1972**

(Published in 37 F.R. 20022, September 23, 1972)

The purpose of these amendments to Parts 23, 27, 91, 121, and 127 of the Federal Aviation Regulations is to revise and clarify the requirements for airplane and rotorcraft manuals, markings, and placards.

These amendments are based on a Notice of Proposed Rule Making (Notice 70-47) issued on November 18, 1970, and published in the Federal Register on November 25, 1970 (35 F.R. 18054). Three comments were received in response to Notice 70-47, one of which favored the proposed amendments. The two comments recommending changes to the proposed amendments are discussed below. Based upon these comments and upon further consideration by the FAA, a number of substantive and editorial changes have been made to the proposed rule. Interested persons have been afforded an opportunity to participate in the making of these amendments, and due consideration has been given to all relevant matter presented. Except as modified by the following discussion, the reasons for these amendments are those in the Notice.

One comment suggested that all aircraft, including those weighing less than 6,000 pounds, should have approved Airplane Flight Manuals containing all of the required information and that placards should be kept on the aircraft for emergency reference only. Commentator stated that a flight manual can be temporarily removed from the aircraft for comfortable reference in a ramp office when outside temperatures are extremely high or low, and that fewer C.G. out of limit or overweight temperature accidents will occur with small aircraft if the total information is available for reference in a comfortable environment. The airworthiness requirements were changed in 1953 to eliminate the requirement for Airplane Flight Manuals for airplanes under 6,000 pounds, and the FAA agrees that this exception should be reconsidered in view of the complexity of small airplanes being type certificated today and the resulting increase in information that must be made available to the pilot. However, that consideration is beyond the scope of Notice 70-47. The Notice proposed amendments to the present regulations which are primarily clarifying in nature and intended to make the present airworthiness standards and operating rules internally consistent. Nevertheless, the comment is appreciated and will be considered for future rule making action. However, in response to the comment and to insure that the information is readily available to the pilot, proposed § 23.1559 has been revised to require the form and location of the "approved manual material" to be specified in the operating limitations placard.

Another comment, while agreeing with the proposed changes to §§ 23.31 and 23.1541, noted that the proposed change to § 23.1559 would eliminate the "operating limitations placard" for airplanes certificated in a single category. This was not the intent of the proposal and proposed § 23.1559(a) has been changed to include airplanes type certificated in only one category. In addition, proposed § 23.1559(a) has been editorially revised to indicate the mandatory status of the operating limitations contained in the Airplane Flight Manual, approved manual material, markings, and placards.

With respect to the proposed amendment to § 23.1581, a commentator opposed the insertion of the word "approved" before the word manual and the requirement that "all approved manual material must be approved, clearly identified and not easily erased, disfigured, or misplaced." The commentator stated that to require FAA approval for material which previously did not require approval would materially complicate a system that has been successfully used by manufacturers for 15 years and that there is no safety justification or administrative need for the requirement. The FAA does not agree. The applicable information in §§ 23.1583 through 23.1589 that proposed § 23.1581 would require to be furnished in an Airplane Flight Manual or in any combination of approved manual material, markings, and placards is necessary for the safe operation of an airplane and the form and manner in which that information is presented to the pilot as well as the information itself should be approved by the FAA. However, proposed §§ 23.1581(b) and 27.1581(b) have been revised to further specify the form and content of the "approved manual material."

Based on further consideration of the requirement in proposed § 27.1581(a)(2) that the information contained in §§ 27.1583 through 27.1589 be furnished not only in a Rotorcraft Flight Manual or approved manual material but also in markings and placards, the proposal has been revised to permit the information to be furnished either in a Rotorcraft Flight Manual or in any combination of approved manual material, markings, and placards. The FAA has determined that it is not necessary for the information contained in §§ 27.1583 through 27.1589 to be furnished in one form and then repeated in the form of markings and placards. As revised the requirement is consistent with the amendment to § 23.1581 and is the same as present § 27.1581(a)(2) except that the option of furnishing the information in approved manual material is provided for in the event that the operating rules of Chapter I do not require a Rotorcraft Flight Manual.

Finally, consistent with the amendments to §§ 23.1559 and 27.1501, § 27.1559 is amended to reflect the option for a helicopter, of using a Rotorcraft Flight Manual or approved manual material to furnish the required operating limitations and to require that the form and location of approved manual material be set forth in the operating limitations placard.

In consideration of the foregoing, Parts 23, 27, 91, 121, and 127 of the Federal Aviation Regulations are amended, effective October 23, 1972.

These amendments are adopted under the authority of sections 313(a), 601, and 603 of the Federal Aviation Act of 1968 (49 U.S.C. 1354, 1421, and 1423), and section 6(c) of the Department of Transportation Act (49 U.S.C. 1655(c)).

Amendment 27–9

Aircraft and Aircraft Engines—Certification Procedures and Type Certification Standards

Adopted: September 20, 1974 **Effective: October 31, 1974**

(Published in 39 F.R. 35452, October 1, 1974)

The purpose of these amendments is to change the procedural requirements relating to the type certification of aircraft and aircraft engines, to update and improve the airworthiness standards applicable to the type certification of aircraft engines, and to incorporate new standards applicable to engines used on supersonic airplanes. In addition, other new airworthiness standards are made applicable to aircraft on which engines type certificated to previous standards are to be installed.

These amendments are based on the Notice of Proposed Rule Making (Notice No. 71–12) published in the Federal Register on May 5, 1971 (36 F.R. 8383). Except for minor editorial changes, and except as specifically discussed hereinafter, these amendments and the reasons therefor are the same as those proposed in Notice 71–12. Numerous comments relating to these proposals were received in response to the Notice and except for those indicating agreement or merely repeating issues discussed and disposed of in the Notice, the FAA's disposition of the significant comments is discussed below. In general, comments received that were beyond the scope of the Notice are not discussed but will be retained for consideration in connection with other rule-making projects as appropriate. Based on the relevant comments and upon further review within the FAA, a number of changes have been made to the proposed rules. In addition, various non-substantive changes of a clarifying and editorial nature have been made. Since these changes impose no additional burden on any person, they may be adopted without further notice and public procedure.

Interested persons have been afforded an opportunity to participate in the making of these amendments, and due consideration has been given to all matter presented.

Two of the proposals of the original Notice concerning engine rotor system unbalance (§§ 25.1305 and 33.29) have been implemented by a separate rule-making action, Amendments 25–35 and 33–5, effective March 1, 1974, that were published in the Federal Register on January 15, 1974 (39 F.R. 1831).

The following discussion is keyed to the like-numbered proposals contained in Notice No. 71–12:

PART 1—DEFINITIONS AND ABBREVIATIONS

Proposal 1—One commentator objected to the inclusion of a turbo-supercharger as part of the engine in the proposed definition of aircraft engines in § 1.1, asserting that in some instances it should be classified as an accessory. However, the intent of the proposal was that turbo-superchargers be included as part of the engine whether or not they are additionally classified as accessories. The definition as adopted has been revised to clarify that a turbosupercharger is part of an engine whether or not it is also an appurtenance or an accessory.

Proposal 2—Several commentators suggested that the term "stop" be deleted from the definition of "idle thrust" as proposed in § 1.1 since a stop is normally associated with the power control lever or throttle, rather than with the engine fuel control device as suggested in the Notice. The FAA agrees with the comment to the extent that the term "idle thrust" should be related to the power control lever and has changed the definition by replacing the term "fuel control device" with "power control lever." Since the term "stop" is appropriate with this revision, it need not be deleted.

One commentator pointed out that several of the proposed amendments used the term "type" in reference to engines and that the word "type" was defined in relation to aircraft in § 1.1 but not to engines. For internal consistency, the definition of "type" has been amended to include the meaning of the term with respect to the certification of aircraft engines.

PART 21—CERTIFICATION PROCEDURES FOR PRODUCTS AND PARTS

Proposal 1—Several commentators suggested that the stress analysis called for in proposed § 21.15(c) for the engine rotor, spacer, and rotor shaft would not normally be available at the time of application for a type certificate, but would be available before actual certification. The FAA agrees and, upon further consideration, has determined that inclusion of the requirement under the type certification standards will allow an applicant to complete and submit a stress analysis after application for a type certificate and before certification. The requirement for a stress analysis has therefore been removed from § 21.15(c) and relocated in a new § 33.62 under the design and construction requirements for turbine aircraft engines.

Proposal 2—Several commentators recommended deletion of that portion of the proposed § 21.35(f) which requires 300 hours of flight test operations for aircraft incorporating engines of a type not previously used in a type certificated aircraft. They contended that the rule discriminated against new engine types, and that unnecessary economic hardships and delays in the aircraft certification program would be imposed. However, experience with newly certificated engine types has demonstrated to the FAA that there is a need for more thorough flight testing of newly certificated engine types, and the regulation with respect to hours of operation is adopted as proposed. Furthermore, the suggestion of one commentator that allowance be made for the use of experimental engines that differ only in minor ways from the type certificated engine has not been adopted because the FAA believes it could lead to uneven administration of the rule.

One commentator questioned whether the phrase "engines that conform to a type certificate" in subparagraph (f)(1) required just one or a full complement of the newly type certificated engines in a multi-engine aircraft. As indicated in the explanation in the Notice, the intent of the FAA is that "engines" means all the engines in the aircraft. To eliminate any ambiguity, the wording has been changed to specifically call for a full complement of engines.

Proposal 3—No public comment was received on the proposal to amend § 21.97 and the section is adopted as proposed.

PART 23—AIRWORTHINESS STANDARDS: NORMAL, UTILITY, AND ACROBATIC CATEGORY AIRPLANES

Proposal 1—One commentator questioned whether proposed § 23.951(b) would prohibit several fuel tanks from gravity feeding through non-return valves to a single collector box from which the fuel pumps would draw fuel. Such an arrangement is not prohibited and the rule would allow any combination of tanks to be used so long as means are taken to prevent air from being introduced into the system.

In response to the suggestion contained in several comments, the icing requirement of paragraph (c) of proposed § 23.951 has been reworded to clarify that it is applicable solely to turbine engine aircraft, since fuel icing is peculiar to turbine fuels. Additionally, since the requirement is intended to preclude interrupted functioning of the fuel system rather than to require operation for an indefinite time, the rule has been revised to require "sustained" operation rather than "continuous" operation.

Proposal 2—Several commentators questioned whether an applicant would have to comply with amended § 23.997, as proposed, if the similar rule in § 33.67 had already been complied with by the engine manufacturer. The FAA proposed the new requirements to assure that newly certificated aircraft would meet the standards prescribed in § 33.67. Thus, if the aircraft manufacturer incorporated an engine which had been type certificated under new § 33.67 the fuel system would already conform to the rule and nothing further would be required. If, however, the aircraft manufacturer incorporated an engine which had not been certificated under the new § 33.67 he would have to take the necessary action to comply with new § 23.997.

Several commentators questioned whether the proposed rule would require that each and every filter in the fuel system, including small screens and so-called "last chance filters," meet the requirements of paragraph (a) through (d) of proposed § 23.997. The FAA intended that at least one filter upstream of the fuel metering device and the engine driven displacement pump meet these requirements, and the section has been clarified accordingly.

In response to a question raised by one commentator concerned with the availability of heat for the required filter or strainer, the FAA wishes to point out that the requirement for icing protection in turbine engine fuel systems, set forth in § 23.951, applies to the entire fuel system.

As proposed, § 23.997(b) would require a drain. Upon further consideration it has been determined that an equivalent of the drain could be provided by having the strainer or filter easily removable for drain purposes and this alternative has been incorporated into the regulation.

Proposal 3—One commentator questioned whether the oil sump of a dry sump engine would be considered as expansion space under the proposal. If the sump is in fact part of the oil tank, then the sump provides the expansion space specified in § 23.1013(b)(1). Further amendment of the requirement is not considered necessary and § 23.1013(b)(1) is adopted as proposed.

One commentator requested clarification of the phrase "that might reduce the flow of oil," used in proposed § 23.1013(e). Several other commentators suggested that the phrase was inconsistent with, but should be identical to, proposed § 25.1013. The FAA agrees with these comments and has revised the section to make it consistent with § 25.1013 in this respect, by specifying that any oil tank outlet screen or guard may not reduce the flow of oil below a safe value at any operating temperature.

Proposal 4—One commentator suggested that the more technically correct term "differential pressure" be used in place of "pressure," in paragraph (c) of § 23.1015. The FAA believes, however, that the present term is adequately understood in the industry, and has not caused any misunderstanding in the past. The paragraph is therefore adopted as proposed.

Proposal 5—Several commentators expressed the belief that the proposed § 23.1019 might be interpreted to require each and every oil strainer or filter in the system including small so-called "last chance" filters to conform to all the requirements of paragraph (a). The intent of the FAA is to require at least one oil strainer or filter that will filter all the oil that passes through the lubricating system while conforming to the requirements of the section. The rule as adopted has been reworded to make this clear. Another commentator objected to the word "conveys" as inappropriate in the lead-in sentence of paragraph (a). The FAA agrees and has changed the wording to refer to a strainer or filter through which all of the engine oil flows.

Several commentators interpreted the requirement of subparagraph (a)(1) for normal oil flow through the bypass as possibly requiring identical flow and proposed the word "adequate" in place of "normal." The FAA does not agree that the word "normal" means identical and used the word normal to mean normal for the system within its operating range. Therefore, the wording as proposed has been retained.

One commentator stated that filters should be serviced on a routine and normal maintenance basis rather than relying upon an indicator as proposed in subparagraph (a)(3). In this connection it should be noted, however, that the rule does not call for relaxing of any maintenance procedures but adds an additional item which will contribute to safety by providing a quick means of inspecting for possible filter contamination.

It was assumed in one comment that the standard engine oil pressure gauge would qualify as an "indicator" as required in proposed subparagraph (a)(3). While it was considered that a separate indicator would be provided, nevertheless, if the applicant can demonstrate that the oil pressure gauge would adequately perform the function of the indicator, a separate indicator would not be required. Upon further consideration, the function of the indicator in terms of contamination of the screen has been reworded for clarity.

Several commentators questioned whether the wording of subparagraph (a)(4) was realistic in requiring that no contaminants be released through the filter bypass. As proposed, the requirement stated an absolute prohibition against release of contaminants. The FAA agrees that the intended purpose may be met by requiring the bypass to be designed to minimize release of contaminants, and the requirement is reworded accordingly.

Proposal 6—Several commentators objected to the requirement in proposed § 23.1093 for operation in falling and blowing snow on the basis that no standard is specified as to the intensity or the amount of falling snow or the degree of blowing involved. They further point out that no uniform means are provided for demonstrating compliance with the section and that a small or even minute amount of snow might satisfy the letter of the law of this section. One commentator offered detailed standards that could be adopted. However, it was not the intent that specifications for all possible conditions be included in the regulation but, rather, that an applicant select the limitations desired for his airplane and then demonstrate the ability to operate within those limitations.

Several commentators asserted that the specified liquid water content of 2 grams per cubic meter was not representative of actual conditions and would result in more stringent requirements for ground operation than for flight, while another suggested that the requirement for icing protection at idle should be applicable "on the ground" rather than at sea level. Upon further consideration, the FAA agrees that a reduction of 0.6 grams would provide an adequate and safe standard for icing protection at idle conditions on the ground and the requirement has been changed accordingly.

One commentator objected to the requirement for icing protection for 30 minutes at idle, stating that there was insufficient bleed air to adequately meet the requirement for this period of time. However, experience has demonstrated that it is practical and necessary for safety of flight, and that protection for the engine during prolonged idle prior to takeoff is essential to safety of operation. The proposal does not restrict the means for icing protection to engine bleed air, as suggested by the commentator, but allows any means or combination of means which the applicant chooses. With respect to bleed air, the intent of the requirement is that icing protection at idle be provided when the bleed air available for icing protection is at its critical condition. The section has been reworded to make this clear.

Proposal 7—Amendment 23–14, effective December 20, 1973, published in the Federal Register on November 19, 1973 (38 F.R. 31816), amended § 23.1183(a) to require that lines and fittings and components carrying gas, air, or flammable fluids in any area subject to engine fire conditions must be at least fire resistant. That amendment also amended the heading of the section, while retaining the requirement that flexible hose assemblies must be approved. Therefore, the section as amended by this amendment, contains the provisions made effective by Amendment 23–14 in addition to those proposed in Notice 71–12, including the revision of the latter discussed below. Inasmuch as the heading proposed in Notice 71–12 is inappropriate to the section as amended by Amendment 23–14, the heading adopted by the amendment is retained.

Stating that proposed § 23.1183, which concerns engine fire protection, is inappropriately included with aircraft airworthiness standards, one commentator suggested that it more correctly belongs in Part 33 relating to engine airworthiness requirements. However, while this and other sections do relate to engine airworthiness, they are included also in Part 23 and the other aircraft certification parts since it is the intent that aircraft certificated under applications made after the adoption of these amendments conform to the new updated sections of Part 33, whether or not they incorporate engines type certificated under the updated Part 33. Thus, to cover cases where such aircraft incorporate engines certificated under applications made before adoption of these amendments, the new engine standards that are appropriate are made effective as to the aircraft by being incorporated in the aircraft airworthiness sections.

One commentator questioned whether integral oil sumps on smaller reciprocating engines were considered to come within the meaning of flammable fluid tanks as that term was used in proposed § 23.1183. The FAA did not intend that they be included, and the rule as adopted specifically provides that integral oil sumps of less than 20 quart capacity need not be fireproof nor be enclosed by a fireproof shield.

Proposal 8—As a result of the issuance of Amendment 23–14 (38 F.R. 31816), which contains new paragraphs, § 23.1305(q) and (r), the proposed paragraphs (q), (r), (s), and (t) are redesignated (s), (t), (u), and (v), respectively. The following discussion is keyed to the new designations.

One commentator questioned whether the fuel strainer or filter indicator referred to in § 23.1305(t) were required on all filters, even "last chance" filters. Consistent with the requirements applicable to the strainers or filters themselves, § 23.1305(t) has been revised to make clear that the indicator required is for a fuel strainer or filter required under § 23.997. Similarly, § 23.1305(t) and (u) have been reworded in order to be consistent with §§ 23.997 and 23.1019, respectively, in regard to the degree of contamination that must be indicated. In response to a further comment, § 23.1305(t) has been reworded to clarify that the desired indication is of the occurrence of contamination rather than the more stringent requirements of the degree of contamination as suggested in the Notice. This change achieves consistency between paragraphs (t) and (u).

One commentator questioned whether other presently installed gauges for other functions could be used as "indicators" to indicate the functioning of a heater as required in paragraph (v). As discussed above, in connection with the indicators required for oil strainers or filters, the FAA anticipates that the requirement will be met by installation of gauges to indicate the functioning of heaters. However, if a clear and positive indication can be obtained from other gauges used to portray functions different than direct heater functioning, the requirements of the section are met.

PART 25—AIRWORTHINESS STANDARDS: TRANSPORT CATEGORY AIRPLANES

Proposed changes to §§ 25.951 (Proposal 1), 25.997 (Proposal 3), 25.1015 (Proposal 5), 25.1019 (Proposal 6), and 25.1093 (Proposal 7) were the subject of comments substantially the same as submitted for the proposed like-numbered sections of Part 23. As adopted, these Part 25 sections set forth the same requirements as proposed in Notice 71-12 except as they have been modified for the reasons given in the preamble discussion of the like-numbered Part 23 sections.

Proposal 2—No comments were received in response to the proposed deletion of § 25.977(b). That paragraph is accordingly revoked and marked reserved.

Proposal 4—The exemption contained in the last sentence of § 25.1013(a), concerning fireproofing of an integral oil sump of less than 20-quart capacity on a reciprocating engine, has been removed from this section and placed in § 25.1183(a). This action involves no substantive change and achieves consistency with the parallel Part 23 section.

Proposal 8—Section 25.1183(a) has been further amended in connection with changes to § 25.1013(a) as noted under Proposal 4.

Proposal 9—Section 25.1305(c) has been amended so that it is substantively the same as the parallel provision of § 23.1305. The related Part 23 preamble discussion is applicable. The proposed new subparagraph 25.1305(d)(3), concerning an indicator to indicate rotor system unbalance, has already been adopted by a separate rule-making action (Amdt. 25-35, 39 F.R. 1831).

One commentator stated that aircraft fuel systems have been designed without cockpit controlled fuel heat; therefore there is no need in proposed subparagraph (c)(8) for an indicator to indicate the proper functioning of any fuel heater. The section however only requires an indicator if a heater is used and the FAA believes it would supply necessary information to indicate heater functioning.

PART 27—AIRWORTHINESS STANDARDS: NORMAL CATEGORY ROTORCRAFT

Proposed changes affecting §§ 27.951 (Proposal 1), 27.997 (Proposal 2), 27.1013 (Proposal 3), 27.1015 (Proposal 4), 27.1019 (Proposal 5), 27.1093 (Proposal 6), 27.1183 (Proposal 7), and 27.1305 (Proposal 8) were the subject of comments substantially the same as submitted for the proposed like-numbered sections of Part 23. The proposed amendments set forth in Notice 71-12 have been adopted except as explained in the preamble discussion of the like-numbered Part 23 sections.

PART 29—AIRWORTHINESS STANDARDS: TRANSPORT CATEGORY ROTORCRAFT

Proposed changes affecting §§ 29.951 (Proposal 1), 29.997 (Proposal 2), 29.1013 (Proposal 3), 29.1015 (Proposal 4), 29.1019 (Proposal 5), 29.1093 (Proposal 6), 29.1183 (Proposal 7), and 29.1305 (Proposal 8) were the subject of comments substantially the same as submitted for the proposed like-numbered sections of Part 23. The proposed amendments set forth in Notice 71-12 have been adopted except as explained in the preamble discussion of the like-numbered Part 23 sections.

PART 33—AIRWORTHINESS STANDARDS: AIRCRAFT ENGINES

Proposal 1—The comments received in response to proposed § 33.5 focused principally on the overhaul instructions that would be required by paragraph (e). The comments revealed widespread misunderstanding of the effect of requiring the engine manufacturer to set out the frequency of overhauls. In this connection, the FAA wishes to point out that overhaul instructions are necessary upon type certification because an engine might require overhaul at any time thereafter, and the ability to perform an overhaul should not be limited by lack of instructions. Furthermore, the manufacturer's statement of overhaul frequency is not established as an operating limitation but operates merely as a recommendation; it does not preclude the establishment of different overhaul intervals, nor does it preclude the "piecemeal" overhaul practice followed by operators using continuous airworthiness maintenance programs. It should be noted, however, that the initial overhaul time established under § 33.90 and referred to in § 33.7(c)(17) is an operating limitation that must be complied with regardless of the adoption of any other practice; the initial overhaul, whether accomplished "piecemeal" or otherwise, must be completed within the time established.

With regard to a question raised by one commentator concerning the requirements in § 33.5(e)(2) that certain component life limits be specified in the required instructions, the FAA wishes to call attention to the fact that no separate requirement is thus established that would have any effect on operators of the engines. The life limits of all components requiring replacement are established under other sections of Part 33 as operating limitations that must be complied with, and their publication in the required instructions is a convenience to operators.

Upon further review, § 33.5(a)(1) is revised to include a requirement that the installation instructions contain the maximum allowable loads for engine mounting attachments and related structure, which are required to be determined in complying with § 33.23. Similarly, § 33.5(a)(2) is revised to include a requirement for description of the pipes, wires, cables, ducts, and cowling covered by that section. That information is considered essential for installation, and FAA practice has been to require it for compliance with prior §33.5.

Proposal 2—The effect of proposed § 33.7 was misunderstood by a number of commentators who objected to various ratings and limitations listed therein. Contrary to the apparent belief of those commentators, no ratings or limitations would be established independently under § 33.7; the section merely contains a list of ratings and limitations established either under applicable requirements of Part 33 that predate the Notice, or under proposed new requirements contained in the Notice. Consideration was thus given to the substance of the comments as they related to substantive requirements proposed in the Notice. Discussion of comments directed to § 33.7 but relating to proposed new requirements is found with other comments under the appropriate section. However, as a result of such comments, one substantive change has been made that affects § 33.7; no rating or limitation need be established for turbine engine internal cooling air flow, and proposed § 33.7(c)(12) has therefore been deleted, with attendant necessary renumbering of the succeeding subparagraphs. Other changes of an editorial nature have been made for internal consistency between § 33.7 and other Federal Aviation Regulations.

Proposal 3—No public comment was received on the proposed deletion of § 33.13, and the section has been revoked and marked "reserved."

Proposal 4—Several comments were received that contained objections to the start-stop stress cycle described in proposed § 33.14 as not being representative of a typical operating cycle that would produce the stresses to be accounted for by the requirement. In particular, there was objection to the requirement that disc and spacer temperatures be stabilized after stopping the engine in order to complete a cycle. The FAA agrees that final temperature stabilization should not be necessary where an applicant can show that the components experience the complete stress range without such stabilization, and the definition of a start-stop stress cycle as adopted includes a provision to allow for such a showing.

Another commentator suggested that the operating limitation be defined as the number of cycles to a detectable crack rather than to failure. The FAA regards a crack as a failure and the rule as adopted applies not only to cracks but to other types of failures which may occur prior to the occurrence of a detectable crack.

A commentator recommended that spacers be deleted from the section because they would not normally be critical. The FAA disagrees; spacers are a critical item in low cycle fatigue, and the requirement, in this regard, is adopted as proposed.

One commentator stated the belief that the establishment of component life limits would result in a complicated and time-consuming process for extending component life. The FAA points out that the listing of this limit on the type certificate as required by this section provides only an initial limit and will not in any way complicate the procedure for extending the limit. In this connection, the section as adopted is revised to clarify that the required operating limitations and the provision for increasing them apply individually to each rotor disc and spacer.

Proposal 5—Several commentators objected to the new standard of protection proposed in § 33.17(b) for external lines, fittings, and components as necessary because the matter is adequately covered in paragraphs (a) and (c) of that section, while another commentator asserted that, due to considerations of airflow and venting, the requirement should be imposed only on the airframe. The FAA does not agree with these positions. The new requirement in (b) for protection against ignition of leaking flammable fluids is necessary to deal with possible impingement of such fluids on hot surfaces. Furthermore, since engine design necessarily includes considerations of airflow and venting, this requirement in Part 33 will assure that those considerations take account of possible ignition of leaking flammable fluid that could result from its impingement on engine components.

In response to comments questioning the applicability of proposed § 33.17(c) to integral oil sumps on the smaller reciprocating engines, the requirement as adopted is revised to exclude such sumps having less than a 20-quart capacity. The requirement is thus made consistent with the parallel requirements in the aircraft airworthiness parts.

One commentator believed that a clear definition of "fireproof" and "fire resistant" was lacking in the regulations and suggested that temperature, duration and flame intensity should be specified as part of any definition. The definitions in § 1.1 of the regulations include both "fireproof" and "fire resistant" and any further changes to these definitions would be outside the scope of the Notice.

One commentator questioned whether under paragraph (e), the accumulation of fluid is interpreted as occurring inside of the engine and suggested that the section should specify unwanted flammable fluid. The FAA agrees that the section is intended to refer to unwanted flammable fluid and is directed to areas internal to the engine. The requirement as adopted is reworded accordingly.

Proposal 6—The comments received in response to proposed § 33.25 expressed general agreement with the intent of the requirement as understood by the commentators. However, several of the comments indicated a need for clarification regarding the applicability of limit loads to accessory drives and mounting attachments. The FAA agrees that the intent of the proposal was that the limit load requirement apply to accessory drives and mounting attachments and the section as adopted is reworded to make this clear.

In addition, as suggested by one commentator, a provision has been added to make clear that the use of engine oil for lubrication of accessory drives and mounting attachments is permitted, with appropriate sealing provisions.

Proposal 7—It was pointed out that reference to "excessive speed, temperature, and vibration" in proposed § 33.27(a) was vague in view of the very specific requirements in proposed paragraph (d). Since it was the intent of the proposal to relate the two requirements, § 33.27(a) as adopted is revised to clearly refer to the specific tests included in the section.

Several commentators objected to the speeds proposed in the overspeed tests required in § 33.27. They expressed the opinion that the rotor speed strength demonstrations which are currently accepted by the FAA and which are 5 percent lower in all cases than the proposed requirements demonstrate an adequate margin of strength.

In this connection, one commentator pointed to 6 million hours of service experience with no disc bursts. The FAA finds compelling merit in these comments and upon further consideration the overspeed requirements as adopted are 5 percent less than those proposed.

Several commentators believed that the proposal to use a test article fabricated with minimum qualities allowed by the specification was an impractical requirement. They expressed the opinion that to conform to the proposal as written would require a component made with all the minimum properties of the specifications, a condition which could not be met. The FAA agrees with these comments and upon further consideration has deleted the proposal.

Several commentators objected to the proposed paragraph (c) of § 33.27 regarding cooling airflow as being too restrictive. They pointed out that in designs where there is more than one cooling passage, one passage could be blocked and still allow passage of an adequate flow of cooling air. While this might be less than normal cooling airflow it might still ensure adequate cooling. The FAA agrees that the proposed requirement would not accomplish the intended purpose and, in connection with the deletion of other proposed requirements relating to cooling airflow that were determined to be impracticable (see discussion relating to §§ 33.7 and 33.87), the section is adopted without the proposed paragraph (c).

Proposal 8—One commentator expressed the opinion that the instrument connection markings required in proposed § 33.29 would be unnecessary if it could be shown that there was no possibility of an instrument being connected to the wrong connection. The FAA agrees that this would satisfy the requirements of the rule and, accordingly, the section as adopted is revised to specifically allow this. In addition, the section has been revised by deletion of the word "new" which was inadvertently included in the proposal, to clarify that it applies to all engine limitations.

The proposed requirement relating to rotor system unbalance contained in proposed § 33.29(b), as noted previously in this preamble, has been adopted in a separate rulemaking action (Amdt. 33-5; 39 F.R. 1831).

Proposal 9—The only public comment received in response to the proposed new § 33.42 recommended deletion of the requirement but gave no reason for the recommendation. The section is adopted as proposed.

Proposal 10—A comment was received that questioned the speed range that would be applicable to the proposed requirement in § 33.43(a) for a vibration survey with a cylinder not firing. As proposed, the requirement implies the same speed range that is applicable to the engine with all cylinders firing. The FAA agrees that this would be impractical and the requirement is revised to specify that the applicable speed range is from idle to maximum desired takeoff speed rating.

Several commentators questioned whether the vibration test survey specified in paragraph (a) required the same propeller used for the endurance test or a propeller of the same configuration. The FAA intended that the same configuration of propeller could be used for the tests and the rule as adopted is revised to clarify the intent for both propellers and loading devices.

One commentator recommended that § 33.43(a) be revised to exclude the propeller shaft or other output shafts from the vibration survey. The FAA does not agree that they should be excluded since they are the most vital components requiring vibration measurements and tests. However, this does not include any accessory drive shafts, which are required to be loaded under § 33.43(c) in order to assess the effects of such loads on the propeller or other output shaft.

One commentator regarded that the number of cycles to demonstrate compliance for fatigue testing of steel shafts specified in § 33.43(b) should be 10 million rather than 10½ million cycles. The FAA agrees that 10 million cycles represents an accepted standard and the requirement is revised accordingly.

A commentator recommended that § 33.43(c) which requires accessories to be loaded during the vibration tests be deleted as being unnecessary for torsional surveys. The FAA does not agree; the *purpose of the test is to disclose* possible adverse vibration effects, including any that might be contributed by accessories.

Proposal 11—Several commentators objected to the proposed § 33.45(b) requirement for a recalibration after the endurance test as being impracticable and unnecessarily adding to the endurance test. They suggested that the intent of the section, to ensure that any power loss during the endurance test be determined, could be met by modifying the rule to require a "power check" in place of a recalibration. The FAA agrees that a full recalibration is not required to determine power loss and the section is revised to require a power check in place of a recalibration. In addition, since the section permits use of measurements taken during the final portion of the endurance test, reference to the finish of that test has been deleted.

Proposal 12—Upon further consideration, the parenthetical statement in the first sentence of paragraph (a) of proposed § 33.49 is revised to clarify that the additional testing requirements that apply to a turbosupercharger are completely covered in § 33.49(e)(1)(iii) (proposed § 33.49(e)(1)(iv)). An applicant may elect to run the engine-turbosupercharger combination an additional 50 hours in complying with that requirement, but it is not necessary to do so.

One commentator felt that in § 33.49, the accessory loading provision referred to in paragraph (a) could be interpreted to require the limit load to be applied during all operations. The intent of this rule is to require limit loads only during operation at rated maximum continuous power and rated takeoff power, and the section is revised accordingly.

One commentator recommended that instead of requiring maximum cylinder temperatures during all of the endurance running at maximum and takeoff powers that a shorter time period would adequately demonstrate cylinder assembly integrity. The FAA agrees with the recommendation and the rule as adopted requires testing with cylinder and oil inlet temperatures specified, for 35 hours, the time currently used in certification practice. Furthermore, the FAA agrees with another commentator that as long as the cylinder temperatures are monitored the intent of the section will be met, and the requirement is revised to refer to cylinder temperature, deleting reference to the cylinder barrel and head.

A commentator recommended that the altitude testing requirements for turbosupercharged engines be deleted and the tests be run at sea level condition. The FAA does not agree. The altitude testing requirements are necessary. However, the section as adopted is revised by rewording the lead-in sentence of § 33.49(e) to allow as an alternative that altitude tests may be simulated, and by deleting proposed § 33.49(e)(1)(iii).

Proposal 13—Several commentators objected that the proposed requirement in § 33.55(b) that all adjustment settings and functioning characteristics that can be established independent of installation on the engine be unchanged at teardown is unnecessarily restrictive. The FAA agrees that the intent of the proposal would be satisfied if those functioning characteristics remain within limits established at the beginning of the endurance test, and the requirement is revised accordingly.

Several commentators believed that the requirement proposed in § 33.55(c) that components conform to the type design after the endurance test was too severe, especially since this would require parts to remain within drawing tolerances. The FAA does not agree. The type design includes dimensions within which a component may change in service. A component that sustains wear beyond those limits during a 150-hour endurance test has not met minimum airworthiness standards.

Proposal 14—The last sentence of § 33.57(b) as proposed is amended to require the engine "or" its parts to be subjected to additional tests if required instead of the engine "and" its parts.

As discussed in connection with Proposal 1 of Part 21, new § 33.62 is added to require stress analysis of certain engine parts.

Proposal 15—A commentator recommended revision of proposed § 33.65 to include reference to the allowable engine operating limitations in order to clarify that there could not be a finding of noncompliance if any of the undesired effects resulted from operations beyond those limitations. The section is intended to apply only to operations that are within allowable operating limitations as set forth in the manufacturer's operating instructions and the requirement is revised to make this clear.

In addition, the section is revised to delete the reference to inlet air distortion caused by cross-wind, which is adequately covered by the manufacturer's specification of limiting inlet air distortion, and to ice ingestion, which is adequately covered by other requirements.

Proposal 16—Several commentators recommended that § 33.66 be clarified to avoid the interpretation that a reduction in engine performance due to bleed air would be an "adverse effect on the engine." To preclude this possible misinterpretation, the section is revised accordingly.

Proposal 17—Several commentators suggested that paragraph (a) of § 33.67 be revised to allow for the use of seals and locking devices as alternatives to making the fuel control adjusting means inaccessible. The FAA agrees that these alternative means be used to achieve the desired intent and the section is revised accordingly.

Several commentators expressed doubt that it should be necessary to add any water to saturated fuel since upon cooling the saturated water would precipitate out, thus representing the most critical condition. The FAA does not agree that the amount of water which may precipitate out properly represents the most critical amount of free water possible in the system. The added water is necessary to simulate critical conditions.

Several commentators expressed doubt that § 33.67(b)(6) could be literally complied with and suggested that the aim of the rule was that all means be taken to prevent the release of contaminants, and that an insignificant amount of contaminant release should not violate the rule. The FAA agrees with this comment and the rule as adopted requires design of the bypass to minimize release of contaminants.

Other revisions to the section have been made for the reasons set forth in the discussion relating to § 23.997, which contains like requirements.

Proposal 18—The comments received in response to proposed § 33.68 were similar to those received in connection with the substantively similar provisions contained in Proposal 6 of Part 23, § 23.1093. The section is revised in accordance with the discussion pertaining to revisions of that section.

Proposal 19—Several commentators objected to the requirement in § 33.69 for two igniters; however, this is the requirement of the present rule and the only proposed change to the rule is the requirement for a single igniter for fuel augmentation systems. No objections were received to this provision.

Proposal 20—Several commentators objected to the requirement in § 33.71(b)(6) for cockpit indication of oil filter contamination, where no bypass is incorporated. However, the FAA considers the addition of a cockpit indicator to be necessary in the interest of safety in order to enable the flight crew to prevent engine failure due to oil starvation, that might occur if all required filters in the lubrication system do not incorporate the protection of a filter bypass.

As indicated by other commentators, the words "extreme temperature" as used in proposed § 33.71(c)(9) could be taken to require compliance at temperatures beyond the intended operating range. Such a result would be contrary to the intent of the requirement and the section as adopted is revised to refer to maximum operating temperature. In response to other comments the differential pressure requirement in subparagraph (c)(9) is reworded to clarify that it may not be less than 5 p.s.i. above the maximum operating pressure of the tank.

One commentator considered that the lack of a requirement for a bypass was a serious deficiency in the proposal. The FAA has considered this question many times including extensive discussion at government-industry airworthiness meetings and has determined that due to the serious divergence of opinion the use of a bypass should at present be optional. If no bypass is used, however, the applicant must comply with other safeguards contained in the section to ensure safe operation of the lubrication system.

The remainder of the comments were similar to those made in response to Proposals 3, 4, and 5 of Part 23 and have been responded to in discussion of those proposals. The section has been reworded in part to conform with the changes made to the sections involved in those proposals.

Proposal 21—One commentator recommended that § 33.72 should refer to a "main" filter only. The FAA does not agree; the requirements are meant to apply to each filter or screen incorporated in the system.

Proposal 22—Several commentators believed that § 33.75 as written was confusing and ambiguous. The printed notice was incorrectly worded and the section is rewritten to read correctly.

Several commentators suggested that the word "burst" in subparagraph (b) was ambiguous and needed further definition. The FAA agrees and, accordingly, a further descriptive phrase, "penetrate its case," is added.

One commentator suggested that the phrase "improper operations" be substituted for "bad operation". The FAA agrees with the suggestion and the section incorporates this change.

One commentator objected to consideration of multiple failures, to avoid consideration of an infinite number of possible failures. The analysis however does not require that all possible multiple failures be considered, but uses the accepted standard of consideration of only the probable single or multiple failures.

Proposal 23—One commentator suggested that § 33.77(a)(2) be clarified to ensure that a burst meant uncontained burst that penetrates the case. The FAA agrees that this is the intent of the section and it is revised accordingly.

Several commenators suggested that the footnote to the table be modified to permit the option of demonstrating containment on a component basis for all the test items. The FAA does not agree that this would adequately account for secondary effects except in the case of blade containment in fan engines as noted.

Several commentators expressed doubt that the proposed rate of ingestion of 1½ pound birds was supported by ornithological data or actual flight experience. They suggested that a lesser rate be used. The FAA, after further study and consideration, agrees. Accordingly, the ingestion rate of 1½ pound birds is established at one for the first 300 square inches of inlet area and at one for each 600 additional square inches or fraction thereof, of up to a maximum of 8 birds.

The practical reality of a 4-inch hailstone was questioned in some of the comments. The FAA, after further study, has determined that this size will probably not be encountered in actual flight conditions and the section is amended to delete the requirement.

Several commentators believed that the amount of sand and gravel specified was excessive and not representative of actual conditions. After further consideration, the FAA agrees that the amount proposed should be reduced and the section is revised accordingly.

The FAA agrees with the point raised by several commentators that, in § 33.77(c), some power or thrust loss should be permitted since the ingestion of these objects will certainly cause a temporary power loss. Accordingly, the requirement is revised to permit power or thrust loss that is not "sustained." In addition, § 33.77(f) is revised, upon further consideration, to require testing of water ingestion to take place under takeoff operating conditions rather than the proposed "maximum cruise." This reflects current practice in engine certification.

The ¼ by 1 inch bolt test is deleted since the test for the broken rotor blade is a more stringent test and will adequately account for the effects of the bolt.

A comment was received that objected to the provision in proposed § 33.77(d)(3) relating to obstruction of induction airflow by foreign objects that are stopped by a protective device. The FAA wishes to point out that the subject provision does not state a requirement that must be met by all applicants. Rather, it provides an alternative to testing for the effects of objects that can be stopped by a protective device and prevented, by deflection out of the airflow path or by some other means, from obstructing the induction airflow in any way.

In addition, a new paragraph (e) is included in § 33.77 to incorporate the suggestion offered by some commentators that the effects of ingestion of some foreign objects can be accounted for by the effects of others. Thus, in showing compliance with § 33.77 (a) the applicant is required to test only for that object that is shown to have the most severe effect. Similarly, for compliance with (b), testing is required for sand and gravel and either the 3 ounce or 1½ pound birds, depending on the size of the engine inlet, as designated in § 33.77(f).

Proposed paragraph (e) is redesignated as paragraph (f).

Proposal 24—One commentator recommended that in § 33.79(a) an acceptable means of compliance to demonstrate cooling be provided for the guidance of the applicant. The FAA, upon further consideration agrees that the section does not adequately establish a definable objective and the proposal is withdrawn for further study. Proposed paragraphs (b) through (f) are redesignated (a) through (e), respectively.

One commentator believed that paragraph (e) of the proposed rule could be misinterpreted as allowing a loss of thrust to the unaugmented engine in an amount equal to that added by the augmentor. To avoid possible misinterpretation, the requirement, adopted in § 33.79(d), is reworded to clarify that the loss of thrust mentioned means only the thrust that is provided by augmentation. Furthermore, upon further consideration, the FAA has revised the requirement to refer only to failure or malfunction of augmentor combustion, since the effects of other possible augmentor failures on engine thrust cannot be reliably predicted.

One commentator recommended clarification of proposed paragraph (f) to ensure that the rotational speed mentioned be the minimum rotational speed at which the thrust augmentation functions. This is the original intent of the paragraph and it is modified accordingly.

Proposal 25—One commentator pointed out an error in th eexplanation of proposed changes to § 33.81. Instead of referring to § 33.43, it should have referred to § 33.87. No change to the adopted rule itself is necessary, however.

Proposal 26—No comments were received on the proposed new § 33.82, and the section is adopted as proposed.

Proposal 27—Several commentators recommended that the requirement in § 33.83 for testing to 110 percent of the desired maximum continuous speed rating be deleted because certain high performance turbine engines may not be capable of achieving this overspeed condition. Upon further consideration, the FAA agrees with the commentators' position and the requirement is deleted.

Other revisions to the section have been made for the reasons set forth in the discussion relating to § 33.43, which contains like requirements.

Proposal 28—Revisions have been made to § 33.85 for the reasons set forth in the discussion relating to § 33.45, which contains like requirements.

Proposal 29—Several commentators requested that the surface temperature requirement be deleted from proposed § 33.87(a)(3) as being difficult to simulate on a test stand. The section is intended by the FAA to require that if an engine external temperature limit be specified by the applicant as being critical, then the applicant must demonstrate satisfactory operation at that temperature. It is pointed out that only those temperatures specified by the applicant need be held at their specified values and the requirement is reworded to clarify this. In addition, the section is revised to provide allowance for more than one test run if all parameters cannot be held at the required values simultaneously.

Several commentators objected to subparagraph (a)(4) of § 33.87 which had called for fuels, lubricants, and hydraulic fluids with the lowest thermal breakdown temperatures allowed by their specifications to be used during the tests . They felt that this was practically an impossible requirement because of the unavailability of fluids and lubricants with all the minimum properties called for. The FAA agrees, and the requirement is revised to call for specified fluids and lubricants used during the endurance tests to conform to their respective specifications.

One commentator suggested that § 33.87(a)(6) be amended to require that only shear and overload loads be tested and that the requirement for other loading during the endurance tests be deleted. The FAA does not agree, but intended that the endurance test simulate actual operation and include testing of the accessories drives themselves as well as other portions of the engine. This requires loading of those drives, and the rule is adopted as proposed.

Several commentators questioned whether the limit load for accessories specified in subparagraph (a)(6) should apply only during maximum power operation. This is the intended construction of the section, and it is amended to reflect this intent.

One commentator expressed concern that compliance with § 33.87(a)(8) which calls for cooling air simulation could not be demonstrated since in a particular engine there may be many divisions of cooling air-flow which might make it virtually impossible to individually regulate each separate cooling airflow path. The FAA agrees with the commentator's position and the proposal is withdrawn for further study.

Several commentators suggested that the references to supersonic engines be deleted because of the lack of foreseeable need for such engines. The FAA does not agree. One of the purposes in formulating these new amendments is to establish standards for that new generation of engines, especially since the FAA is in the process of presently certificating such engines.

One commentator pointed out that the proposal did not include the false start tests of the present rule. This was an inadvertent omission and those false start tests are included in the adopted rule.

Proposal 30—The phrase "for installation in an engine" is deleted from § 33.88 as being surplusage.

Proposal 31—One commentator requested that a better definition be used in § 33.89 (b) for the term "extreme ambient temperature and altitude." The FAA agrees that, taken literally, the requirement could be unnecessarily burdensome. Accordingly, the wording is modified to read "maximum and minimum operating ambient temperature" and "maximum operating altitude." In addition, upon further consideration, the last sentence of the proposed requirement is deleted as unnecessary.

Proposal 32—One commentator believed that for the overhaul test of § 33.90 two starts per hour was unnecessarily severe and suggested that a number representative of intended operation might be substituted for the stated requirement. The FAA agrees that if the applicant could show that a lesser number of starts would be more representative of intended operation for the particular engine that this would adequately comply with the intent of the section, and the section is revised accordingly. Furthermore, since this revision eliminates the distinction in the section between airplane and rotorcraft engines, the requirement is expressed in a single paragraph, rather than in (a) and (b) as proposed.

In response to several comments, § 33.90 as adopted is revised to clarify that the requirement applies only to engines being originally type certificated; it does not apply to engines being certificated through amendments to existing type certificates or through supplemental type certification procedures.

Several commentators recommended deleting the entire section as proposed. They expressed the opinion that it was unreasonable to require the completion of an overhaul test in addition to the endurance test as a condition of type certification and believed that past practices were adequate to establish an initial overhaul period. One commentator stated that the 150 hour endurance test, because of its accelerated nature, should be equivalent to a 1000 hour overhaul period. The FAA does not agree. This additional overhaul test is necessary since experience on certain engines has shown that the endurance test has not been equivalent to longer service operations, especially for periods as long as 1000 hours.

Proposal 33—Several commentators pointed out that the oil tank requirement in paragraph (c) of proposed § 33.91 was redundant with a similar proposed requirement in proposed § 33.71(c)(9). The specified test requirements for oil tanks are covered under § 33.71(c)(9) and reference to oil tanks is, therefore, not included in § 33.91(c) as adopted. References to "extreme temperature" and "the sum of 5 p.s.i. and the maximum operating pressure" in the requirements specified in § 33.91(c) have been revised for reasons discussed in connection with Proposal 20, this Part (§ 33.71). In addition, and for the same reason, references to "extreme temperature" in § 33.91(d) have been replaced by "maximum and minimum operating temperature", and the requirement to test while cycling operating conditions from "one extreme to another" has been rewritten to require cycling between maximum and minimum operating conditions.

Proposal 34—Several commentators expressed the opinion that the tests required under § 33.92 are unnecessary for engines that are to be used in single engine aircraft. One commentator further suggested that the time period of 3 hours may not be appropriate to a practical situation but rather, the time period and r.p.m. should be based upon the conditions arising from a recommended flight technique following an engine failure at a critical point in the flight path. Another commentator expressed doubt that windmilling for 3 hours without oil was a normal expectancy. The FAA does not agree. It is not possible, at the time of certification, to know the end use or particular intended flight conditions for each engine. It is therefore necessary to establish a general criterion which will adequately demonstrate a degree of safety for conditions that a turbine engine would likely encounter on a typical and usual route structure. The 3 hour time period specified does represent a time period representative of an expected route structure and windmilling for 3 hours without oil is a reasonable possibility.

One commentator recommended that the proposed rule be clarified to specifically allow for the engine windmilling speed to either decrease or stop due to freezing of bearings. The proposal as written does not specifically mention this condition. However, the FAA agrees that this would be a satisfactory means of accomplishing the intent of the section and the rule is revised to allow for this condition.

One commentator recommended deletion of the entire section because he believed there was insufficient experience pointing out a need for these tests and because the proposal implies a flight test as a condition of engine certification. The FAA finds that experience establishes the need for these tests and points out that flight tests are not specifically required by the rule.

Proposal 35—The changes to § 33.93 are similar to those made for § 33.55, which was the subject of similar comments. The changes and comments are discussed in connection with Proposal 13, this Part.

Proposal 36—The changes to § 33.99 are similar to those made for § 33.57, which was the subject of similar comments. The changes and comments are discussed in connection with Proposal 14, this Part.

Finally, it should be noted that a number of the rule changes contained in this amendment deal with subjects for which proposals were received for inclusion in the 1974–75 Airworthiness Review Program (Notice 74-5; 39 F.R. 5785). As indicated in that Notice and in Notice 74-5A (39 F.R. 18662), inviting comment on the proposals received, rule making procedures separate from the Airworthiness Review could result in removal of proposals from further consideration during the Airworthiness Review Program. The FAA has determined that the following FAA proposals presently being processed in the 1974–75 Airworthiness Review relate to issues that are covered by the rules adopted by these amendments, and need not, and will not, be given further consideration during the 1974–75 Airworthiness Review:

Proposal No.	*FAR'S*	*Subject*
677 (with respect to proposed paragraph (q) only)	§ 23.1305	Powerplant instruments
752	§ 25.997	Fuel strainer or filter
784	§ 25.1305	Powerplant instruments
863	§ 27.1305	Powerplant instruments
941	§ 29.1183	Lines and fittings
947	§ 29.1305	Powerplant instruments

These amendments are made under the authority of sections 313(a), 601, and 603 of the Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421, and 1423), and of section 6(c) of the Department of Transportation Act (49 U.S.C. 1655(c)).

In consideration of the foregoing, Parts 1, 21, 23, 25, 27, 29, and 33 of the Federal Aviation Regulations are amended as follows, effective October 31, 1974.

Amendment 27-10

Airworthiness Review Program

Amendment No. 2: Rotorcraft Anticollision Light Standards

Adopted: February 3, 1976 **Effective: February 5, 1976**

(Published in 41 F.R. 5290, February 5, 1976)

The purpose of these amendments to Parts 27 and 29 of the Federal Aviation Regulations is to revise the type certification requirements for rotorcraft anticollision lights.

These amendments are based upon a Notice of Proposed Rule Making (Airworthiness Review Program Notice No. 5: Equipment and Systems Proposals; Notice 75-23) published in the Federal Register on May 27, 1975 (40 F.R. 23048) and are the second in a series of amendments to be issued as part of the First Biennial Airworthiness Review Program (ref. Notice 74-5, 39 F.R. 5785). The first series of amendments were published in the Federal Register on January 14, 1975 (40 F.R. 2576). Numerous comments were received in response to Airworthiness Review Program Notice No. 5, which the FAA is currently reviewing. However, the FAA has currently under consideration an application for a type certificate of a rotorcraft for which the current anticollision light requirements would create objectionable multiple reflections and from which the applicant has requested relief. Therefore, considering that the rotorcraft may be type certificated before the final disposition of Airworthiness Review Program Notice No. 5 (Notice 75-23) can be completed, the FAA believes it appropriate to expedite rule-making action with respect to the anticollision light standards in Proposal Nos. 5-50 and 5-63.

Interested persons have been afforded an opportunity to participate in the making of these amendments and due consideration has been given to all matter presented. A number of substantive changes have been made to the proposed rules based upon the relevant comments received and upon further review within the FAA. Except for the substantive changes discussed hereinafter, these amendments and the reasons therefore are the same as those contained in Proposal Nos. 5-50 and 5-63.

Several commentators objected to proposed amendments to §§ 27.1401(b) and 29.1401(b) concerning the increase in field of coverage requirements. The FAA believes, after considering the comments and upon further review within the FAA, that the increase in field of coverage for rotorcraft anticollision lights even at the reduced intensity proposed would result in increased reflections in the cockpit from the rotor blades. These increased reflections could seriously interfere with the crew's vision. Accordingly, the portions of Proposal Nos. 5-50 and 5-63 concerning an increase in the field of coverage from 30° to 75° for rotorcraft anticollision lights are withdrawn.

One commentator stated that any proposal concerning anticollision lights should be discussed with the International Civil Aviation Organization (ICAO). However, the proposals as adopted will provide the same color requirement as the international standard for airplanes. With regard to intensity levels, which are not an international standard but are set forth in an ICAO acceptable means of compliance for airplanes, the adopted intensity levels would still meet that acceptable means of compliance.

No other adverse comment was received on proposed §§ 27.1401(d) and 29.1401(d) which would require that the color of anticollision lights installed on rotorcraft be aviation red. Accordingly, proposed §§ 27.1401(d) and 29.1401(d) are adopted without substantive change.

No other adverse comment was received on proposed §§ 27.1401(f) and 29.1401(f) that would reduce the minimum effective intensity requirements for anticollision lights installed on rotorcraft. Accordingly, proposed §§ 27.1401(f) and 29.1401(f) are adopted except that the minimum effective intensity requirement for the 30° to 75° range has been deleted as discussed herein.

These amendments are in the interest of safety because they will provide for the type certification of rotorcraft with less objectionable multiple reflections caused by the higher intensity levels. Since they also relieve a restriction, I find that good cause exists for making them effective in less than 30 days.

These amendments are made under the authority of sections 313(a), 601, and 603 of the Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421, and 1423), and of section 6(c) of the Department of Transportation Act (49 U.S.C. 1655(c)).

In consideration of the foregoing, Parts 27 and 29 of the Federal Aviation Regulations are amended as follows, effective February 5, 1976.

Amendment 27-11

Airworthiness Review Program

Amendment No. 3: Miscellaneous Amendments

Adopted: December 13, 1976 **Effective: February 1, 1977**

(Published in 41 FR 55454, December 20, 1976)

The purpose of these amendments is to update and improve—(1) the aircraft, engine, and propeller certification regulations; (2) the operating regulations containing airworthiness standards; and (3) related procedural requirements.

These amendments are based on a notice of proposed rule making (Notice 75-10) published in the FEDERAL REGISTER on March 7, 1975 (40 FR 10802) and are the third in a series of amendments to be issued as part of the First Biennial Airworthiness Review Program. The following series of amendments have previously been issued as part of this Airworthiness Review Program:

Title	*Federal Register citation*
Form number and clarifying revisions	(40 F.R. 2576; Jan. 14, 1975)
Rotorcraft anticollision light standards	(41 F.R. 5290; Feb. 5, 1976)

Interested persons have been afforded an opportunity to participate in the making of these amendments and due consideration has been given to all matter presented. A number of substantive changes and changes of an editorial and clarifying nature have been made to the proposed rules based upon the relevant comments received and upon further review within the FAA. Except for the minor editorial and clarifying changes and the substantive changes discussed hereinafter, these amendments and the reasons therefore are the same as those contained in Notice 75-10.

After issuing Notice 75-10, the following six additional notices of proposed rule making were issued as part of the First Biennial Airworthiness Review Program.

Notice No.	*Federal Register citation*	*Title*
75-19	40 F.R. 21866; May 19, 1975.	Notice No. 3: Powerplant Proposals.
75-20	40 F.R. 22110; May 20, 1975.	Notice No. 4: Equipment Deviation List.
75-23	40 F.R. 23048; May 27, 1975.	Notice No. 5: Equipment and Systems Proposals.
75-25	40 F.R. 24664; June 9, 1975.	Notice No. 6: Flight Proposals.
75-26	40 F.R. 24802; June 10, 1975.	Notice No. 7: Airframe Proposals.
75-31	40 F.R. 29410; July 11, 1975	Notice No. 8: Aircraft, Engine, and Propeller Airworthiness, and Procedural Proposals.

Based upon further review by the FAA, a number of proposals which were contained in Notice 75-10 are not being dealt with herein but will be considered in conjunction with other proposals contained in one of the later Airworthiness Review Program Notices of proposed rule making.

The following discussion is keyed to the like-numbered proposals contained in Notice 75-10:

Proposal 2-1. One commentator suggested that the proposed change to § 21.33(a) be revised to limit the new aircraft engine and propeller inspection and test provisions to prototypes only. The FAA does not agree. The intent of the proposals was to make the inspection and test requirements in § 21.33(a) compatible for aircraft, aircraft engines, and propellers. The provision applies to the item presented for type certification tests irrespective of whether or not the item is considered a prototype by the applicant for the type certificate. The proposal is therefore, adopted without substantive change.

Proposal 2-2. No unfavorable comments were received on the proposal to amend § 23.23. Accordingly, the proposal is adopted without substantive change.

Proposal 2-3. No unfavorable comments were received on the proposal to amend § 23.141. Accordingly, the proposal is adopted without substantive change.

Proposal 2-4. No unfavorable comments were received on the proposal to amend § 23.143(b). Accordingly, the proposal is adopted without substantive change.

Proposal 2-5. No unfavorable comments were received on the proposal to amend § 23.145. Accordingly, the proposal is adopted without substantive change.

Proposal 2-6. The proposed change to § 23.149(b) concerning the language "without exceptional piloting skill, alertness, or strength" is related to a proposed amendment to § 23.149 that is contained in Airworthiness Review Program, Notice No. 6: Flight Proposals (Notice 75-25; 40 FR 24664; June 9, 1975). The proposed amendment to § 23.149(b) contained in Notice No. 2 is therefore being deferred until final rule making action is taken with respect to the related proposal in Notice 75-25. Comments submitted for Proposal 2-6 will be considered at that time.

Proposal 2-7. Although no unfavorable comment was received on the proposal to amend § 23.175(c), the FAA believes that clarification is necessary. The term "or thrust" has been added to the end of the language "maximum cruising power" in proposed § 23.175(c)(3). Proposed § 23.175(c)(4) was intended to clarify the requirement concerning trim speed, but the FAA believes the conflict in language with a similar provision in § 23.175(b)(2)(iii) may cause confusion. Therefore, proposed § 23.175(c)(4) is withdrawn.

Proposal 2-8. The proposed change to § 23.253(b) is related to a proposed amendment to § 23.253(b)(3) that is contained in Airworthiness Review Program, Notice No. 8: Aircraft, Engine, and Propeller Airworthiness, and Procedural Proposals (Notice 75-31; 40 FR 29410 July 11, 1975). The proposed amendment to § 23.253(b) contained in Notice No. 2 is therefore being deferred until final rule making action is taken with respect to the related proposal in Notice 75-31. Comments submitted for Proposal 2-8 will be considered at that time.

Proposal 2-9. No unfavorable comments were received on the proposal to amend § 23.397. Accordingly, the proposal is adopted without substantive change.

Proposal 2-10. No unfavorable comments were received on the proposal to add a new § 23.479(d). Accordingly, the proposal is adopted without substantive change.

Proposal 2-11. One commentator objected to the proposed use of the language "materials used for parts, the failure of which could adversely affect safety" in place of the language "materials used in the structure" in §§ 23.603(a) and 25.603. The FAA does not agree with the commentator's suggestion that all parts of the airplane should, unless specifically excluded, be considered structure. The FAA believes that consideration of the suitability and durability of materials used should be broadened to include parts not normally considered airplane structure.

Proposal 2-12. No unfavorable comments were received on the proposal to amend § 23.607. Accordingly, the proposal is adopted without substantive change.

Proposal 2-13. A commentator questioned whether proposed § 23.675 would require that stops provided to limit the range of motion of an aerodynamic surface be located only on the aerodynamic surface or whether the stop could be located adjacent to the surface. Section 23.675, as proposed and as adopted herein, without change, requires that stops positively limit the range of motion of moveable aerodynamic surfaces. This can be accomplished by locating the stop on structure adjacent to the surface.

Proposal 2-14. No unfavorable comments were received on the proposal to amend § 23.685(a). Accordingly, the proposal is adopted without substantive change. See proposal 2-109.

Proposal 2-15. No unfavorable comments were received on the proposal to add a new § 23.733(c). Accordingly, the proposal is adopted without substantive change.

Proposal 2-16. No unfavorable comments were received on the proposed new § 23.787(f). However, one commentator pointed out that the word "contract" in the proposal as printed in the Federal Register should be "contact." The proposal has been corrected to eliminate the printing error. The proposal has also been clarified based on a comment received on Proposal 2-111, to avoid any implication that lamps will be required in cargo compartments.

Proposal 2-17. One commentator questioned the need in proposed § 23.841(b)(6) for a warning indicator at the pilot station to indicate when a cabin pressure altitude of 10,000 feet is exceeded. But as noted by the commentator it is a general industry practice to provide this warning at a cabin altitude of 10,000 feet. The FAA believes that due to the larger number of small airplanes having such awarning many pilots may come to rely on the warning at this cabin altitude. The proposal is therefore adopted without substantive change.

Proposal 2-18. The proposed changes to §§ 23.853, 27.853, and 29.853 concerning the certification requirements necessary to permit smoking in certain aircraft categories are related to proposed standards for § 25.853. The amendments proposed for § 25.853 are contained in Airworthiness Review Program Notice No. 2: Miscellaneous Proposals (Notice 75-10; 40 FR 10802; March 7, 1975) and in Airworthiness Review Program Notice No. 8: Aircraft, Engine, and Propeller Airworthiness, and Procedural Proposals (Notice 75-31; 40 FR 29410; July 11, 1975). The proposals for § 25.853 in Notice 75-10 is being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75-31. The proposed amendments to §§ 23.853, 27.853 and 29.853 contained in Notice 75-10 are therefore being deferred until final rulemaking action is taken with respect to the related proposal for § 25.853. Comments submitted for Proposals 2-18, 2-114, and 2-160 will be considered at that time.

Proposal 2-19. One commentator suggested a clarification of proposed new § 23.903(b) noting that the language, "must be designed to give reasonable assurance" would be subject to divergent application. The same language is now used in § 25.903(d)(2), and the FAA believes that experience with this provision in transport category type certification has been satisfactory.

One commentator suggested that a provision similar to § 25.903(d)(1) concerning design precautions to minimize hazards to the airplane in the event of an engine rotor failure be included in proposed §§ 23.903(b), 27.903(c), and 29.903(f). Although several airworthiness directives have been issued to prevent the failure of engine rotors in one engine type, the FAA does not believe that a general requirement for §§ 23.903(b), 27.903(c), or 29.903(f) that is identical to § 25.903(d)(1) is necessary at this time.

Proposal 2-20. No unfavorable comments were received on the proposal to amend § 23.933(b). Accordingly, the proposal is adopted without substantive change.

Proposal 2-21. One commentator objected to proposed new § 23.941 concerning airplanes with variable inlet or exhaust system geometry as being unnecessary and unjustified in Part 23. The FAA agrees that this provision should not be added to Part 23 at this time and is therefore withdrawing the proposal.

Proposal 2-22. One commentator suggested that the proposed changes to §§ 23.971 and 23.999 be revised to require a quick actuation drain valve on each fuel tank. The proposal, however, was not to require new drainage outlets but to establish standards for the drains set forth in proposed § 23.971(b) and present § 23.999(a). The FAA does not have sufficient information to indicate that a need exists for a quick actuation drain valve on each fuel tank considering the large number of different types of fuel tanks which are included on Part 23 airplanes and the use of sediment bowls and chambers. The proposal is therefore adopted without substantive change.

Proposal 2-23. One commentator question the proposed requirement in § 23.977(a)(2) that a turbine engine fuel strainer prevent the passage of any object that could restrict fuel flow or damage any fuel system component. The commentator asserted that a strainer which met this requirement would have an opening so small that ice accumulation with the use of turbine fuels would be a problem. The FAA does not agree. This is identical to the provision in § 25.977(a)(2). Experience with fuel strainers that would meet the proposed standards in § 23.977(a)(2) has shown that a strainer can prevent the passage of the noted objects and also prevent ice accumulation.

One commentator noted that the clear area of each fuel tank outlet strainer should be at least six times the area of the outlet line instead of five times as proposed in § 23.977(b). This provision is identical to § 25.977(c) and the FAA considers that experience with this requirement in Part 25 has been satisfactory.

Proposal 2–24. The intent of the proposal to add a new § 23.979(e) was to provide strength requirements including load factors, applicable to the airplane defueling system to cover surge pressure during defueling. Upon further review the FAA believes that the proposed amendment is premature. Therefore, the proposal is withdrawn.

Proposal 2–25. No unfavorable comments were received on the proposal to amend § 23.995(d). Accordingly, the proposal is adopted without substantive change.

Proposal 2–26. One commentator suggested that there should be sufficient clearance between the quick actuation drain and other parts of the airplane to allow the fuel sample to be drained into a typical, small container. The FAA believes fuel system drains which meet the proposed requirements of paragraphs(b)(1) and (b)(3) of § 23.999, that the drain discharge clear of all parts of the airplane and that it be readily accessible, will have sufficient clearance to allow a fuel sample to be drained into a small container.

One commentator suggested that the requirement in § 23.999(b)(1)) that the drain must discharge clear of all parts of the airplane, would create unnecessary design and construction restraints. The FAA believes that by coating some airplane surfaces with fuel or by trapping quantities of fuel in certain locations a fire hazard exists. This fire hazard should be limited by this proposal. Further, the FAA believes this requirement can be met without an undue restraint on airplane design.

A commentator asserted that the proposed requirement in § 23.999(b)(3), that the drain valve be either located or protected so that it will not be damaged in the event of a landing with landing gear retracted cannot be justified. The commentator noted that the fuel tanks would be ruptured in such a landing and nothing would be gained if the drain was protected. The FAA disagrees, similar fuel tank installation requirements are set forth in § 23.967 and experience indicates that the fuel system can and should be either located or protected to prevent fuel leakage in such a landing. The FAA does agree that the proposal needs to be clarified to more specifically provide a design specification and has, so modified paragraph (b)(3). Also see Proposal 2–70.

Proposal 2–27. No unfavorable comments were received on the proposal to add a new § 23.1093(c). Accordingly, the proposal is adopted without substantive change.

Proposal 2–28. Proposed § 23.1111(c) was misunderstood by one commentator who asserted that it is not possible to assure the impossibility of failure of the engine lubricating system. The proposal, however, was directed toward the elimination of hazardous contamination of the cabin air assuming a failure of the engine lubricating system. In consideration of the misunderstanding, the language has been revised to emphasize the prevention of hazardous contamination of cabin air system.

Proposal 2–29. Although no unfavorable comment was received on the proposed § 23.1125, the FAA believes that the proposal could misunderstood as to whether use of the heat exchanger would permit or prohibit the passage of exhaust gases through the exchanger when hot air was not being directed to the area where it was intended to be used. The FAA's intention was to require cooling of the exchanger wherever it was in contact with exhaust gases, regardless of its usage status. The proposal is revised to make this clear using the language of §§ 25.1125(a)(3) and 29.1125(a)(3). The FAA believes that the exhaust heat exchange requirements should be paralleled in Parts 23, 25 and 29. Therefore the proposed changes to §§ 25.1125(a)(3) and 29.1125(a)(3) are withdrawn.

Proposal 2–30. No unfavorable comments were received on the proposal to amend § 23.1143. Accordingly, the proposal is adopted without substantive change.

Proposal 2–31. One commentator believed that proposed § 23.1165(e) was unnecessarily restrictive in requiring all ignition systems to be independent of all other electrical systems. The FAA agrees with respect to reciprocating engines since § 33.37 requires a dual ignition system or an ignition system of equivalent inflight reliability for reciprocating engines and § 23.903 requires each engine installed on small airplanes to be type certificated under Part 33. However, the FAA disagrees with respect to turbine engines since two separate primary electrical circuits are not required in § 33.69. The rule as adopted is applicable to turbine engines installed on small airplanes only.

Proposal 2-32. One commentator objected to the proposal to add a speed warning device for turbopropeller powered airplanes. The FAA believes that due to the characteristics of turbopropeller powered airplanes that make it desirable to operate at the maximum operating limit speed (V_{MO}/M_{MO}), and the increasing preoccupation of pilots with air traffic and other duties which distract them from continuous monitoring of airspeed instruments overspeed conditions can be a problem. Therefore, to insure early warning and thus to make a major portion of the speed margin available for pilot reaction and recovery maneuvers, the amendment requires that the speed warning device must give effective aural warning (differing distinctively from aural warnings used for other purposes) to the pilots whenever the speed exceeds V_{MO} plus 6 knots or $M_{MO}+0.01$.

It should also be noted that the proposal for § 23.1303(d) has been revised to make it like § 25.1303(a)(1) to allow for an air temperature indicator which provides indications that are convertible to free-air temperature.

Proposal 2-33. No unfavorable comments were received on the proposal to amend § 23.1309. Accordingly, the proposal is adopted without substantive change.

Proposal 2-34. One commentator suggested that proposed §§ 23.1322 and 25.1322 concerning warning, caution, and advisory light be revised. The commentator noted that requiring a blue light for position indication was not always appropriate since blue was difficult to see in direct sunlight but was readily distinguishable in heavily shaded installations. The FAA agrees that blue should not be an established standard applicable to all installations. Therefore proposed §§ 23.1322(d), 25.1322(d), 27.1322(d) and 29.1322(d), concerning blue lights, are withdrawn. Also see Proposal 2-82.

Proposal 2-35. The proposed amendments to §§ 23.1325, 25.1325, and 29.1325 concerning the static pressure sources are related to proposed amendments to § 27.1325 that are contained in Airworthiness Review Program, Notice No. 2: Miscellaneous Proposals (Notice 75-10; 40 FR 10812; March 7, 1975) and in Airworthiness Review Program, Notice No. 5: Equipment and System Proposals (Notice 75-23; 40 FR 23048; May 27, 1975). The proposed amendment to § 27.1325 in Notice 75-10 is being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75-23. The proposed amendments to §§ 23.1325, 25.1325, and 29.1325 contained in Notice 75-10 are therefore being deferred until final rulemaking action is taken with respect to the related proposed amendments to § 27.1325. Comments submitted for Proposals 2-35, 2-83, and 2-183 will be considered at that time.

Proposal 2-36. One commentator questioned the proposed lead-in for § 23.1331(b). The commentator interpreted the proposal to mean that each instrument must have independent power sources and noted that the explanation did not indicate this to be intended. The FAA agrees that the proposal is not clear, and the proposal is withdrawn.

Proposal 2-37. The proposed change to § 23.1335 concerning the deletion of the section is related to a proposed amendment to § 23.1335 that is contained in Airworthiness Review Program, Notice No. 5: Equipment and Systems Proposals (Notice 75-23; 40 FR 23048; May 27, 1975). The proposed amendment to § 23.1335 contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75-23. Comments submitted for Proposal 2-37 will be considered at that time.

Proposal 2-38. No unfavorable comments were received on the proposal to amend § 23.1351. Accordingly, the proposal is adopted without substantive change.

Proposal 2-39. Proposed § 23.1353(f) concerning nickel-cadmium batteries is related to a proposed amendment to § 23.1581 that is contained in Airworthiness Review Program, Notice No. 6: Flight Proposals (Notice 75-25; 40 FR 24664; June 9, 1975). The proposed amendment to § 23.1353 contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75-25. Comments submitted for Proposal 2-39 will be considered at that time.

Proposal 2-40. For comments related to the proposed amendment of § 23.1385, see Proposal 2-89.

Proposal 2-41. One commentator suggested that proposed § 23.1411(b)(2) be revised to conform to the language in § 25.1411(b)(2). The FAA, however, believes a more specific standard is appropriate for §§ 23.1411 and 27.1411. Therefore, the proposed amendments to §§ 23.1411 and 27.1411 are adopted without substantive change.

Proposal 2-42. One commentator suggested that the proposed change to § 23.1549 be revised to accommodate horizontal scale powerplant instruments. The FAA agrees, and §§ 23.1549, 27.1549 and 29.1549, as adopted, will provide marking standards appropriate to circular, horizontal and vertical scale powerplant instruments.

Proposal 2-43. The proposed change to § 23.1555 concerning the information requirements of usable fuel in a restricted use fuel tank is related to a proposed amendment to § 23.1581 that is contained in Airworthiness Review Program, Notice No. 6: Flight Proposals (Notice 75-25; 40 FR 24664; June 9, 1975). The proposed amendment to § 23.1555 contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75-25. Comments submitted for Proposal 2-43 will be considered at that time.

Proposal 2-44. The proposed change to § 23.1557 concerning the system voltage marking requirement adjacent to its external power connection is related to a proposed amendment to § 23.1557 that is contained in Airworthiness Review Program, Notice No. 3; Powerplant Proposals (Notice 75-19; 40 FR 21866; May 19, 1975). The proposed amendment to § 23.1557 contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75-19. Comments submitted for Proposal 2-44 will be considered at that time.

Proposal 2-45. The proposed change to § 23.1581 concerning the Airplane Flight Manual is related to a proposed amendment to § 23.1581 that is contained in Airworthiness Review Program, Notice No. 6: Flight Proposals (Notice 75-25; 40 FR 24664; June 9, 1975). The proposed amendment to § 23.1581 contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related Proposal in Notice 75-25. Comments submitted for Proposal 2-45 will be considered at that time.

Proposal 2-46. The proposed change to § 23.1587(a)(2) is related to proposed amendments to § 23.1587 that were contained in Airworthiness Review Program, Notice 6: Flight Proposals (Notice 75-25; 40 FR 24664; June 9, 1975). The proposed amendment to § 23.1587 contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75-25. Comments submitted for Proposal 2-46 will be considered at that time.

Proposal 2-47. One commentator suggested that considering the proposed deletion of §§ 25.45 through 25.75, current § 25.161(e) will need to be amended to replace the reference to § 25.69. The FAA agrees, and § 25.161(e)(1) is amended by striking the reference to § 25.69 and inserting in place thereof a reference to § 25.123(a). In addition, the FAA has found that § 25.201(c)(1) refers to § 25.49(c)(2)(i) that would also be deleted. Therefore, § 25.201(c)(1) as amended strikes the phrase "§ 25.49(c)(2)(i) for reciprocating engine powered airplanes, or in" and the phrase "for turbine engine powered airplanes".

Proposal 2-48. No unfavorable comments were received on the proposed change to strike the words "turbine powered" from § 25.101(a). Accordingly, proposed § 25.101(a) is adopted without substantive change.

No unfavorable comments were received on proposed § 25.101(b) and it is adopted as proposed except that it is clarified to indicate that the 80% relative humidity for reciprocating engines is based on standard atmospheric temperature (the vapor pressure values in the table in proposed § 25.101(b)(2) correspond to 80% relative humidity with a standard atmosphere).

Proposal 2-49. Based on comments reveived on the proposal to amend § 25.105 and on the related proposals to §§ 25.125, 25.241 and 25.1533(c), and upon further review by the FAA, Proposals 2-49, 2-51, 2-52 and the portion of 2-93 dealing with the new operating limitation requirements for transport category airplanes intended to be used in operations on unpaved runways are withdrawn.

Proposal 2-50. No unfavorable comments were received on the proposal to amend § 25.107. Accordingly, the proposal is adopted without substantive change.

Proposal 2-51. For comments related to the withdrawal of the proposed amendment of § 25.125, see Proposal 2-49.

Proposal 2-52. For comments related to the withdrawal of the proposal to add a new § 25.241, see Proposal 2-49.

Proposal 2-53. No unfavorable comments were received on the proposal to amend § 25.397. Accordingly, the proposal is adopted without substantive change.

Proposal 2-54. For comments related to the proposed amendment of the lead-in of § 25.603, see Proposal 2-11.

Proposal 2-55. No unfavorable comments were received on the proposal to amend § 25.675. Accordingly, the proposal is adopted without substantive change. Also see Proposal 2-13.

Proposal 2-56. No unfavorable comments were received on the proposal to amend § 25.685(a). Accordingly, the proposal is adopted without substantive change. See Proposal 2-109.

Proposal 2-57. No unfavorable comments were received on the proposal to add a new § 25.733(c). Accordingly, the proposal is adopted without substantive change.

Proposal 2-58. One commentator questioned whether the proposed § 25.775(e) would require that there be at least two windshield panels in the windshield for each pilot. The intent of the proposal, however, is to provide at least one windshield panel through which at least one pilot could see if vision was lost through another panel.

Proposal 2-59. Proposed § 25.783(g) concerning integral stairs installed in passenger entry doors that qualify as passenger exits is related to a proposed amendment to § 25.783 that is contained in Airworthiness Review Program, Notice No. 8: Aircraft, Engine, and Propeller Airworthiness, and Procedural Proposals (Notice 75-31; 40 FR 29410; July 11, 1975). The proposed amendment to § 25.783(g) contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75-31. Comments submitted for Proposal 2-59 will be considered at that time.

Proposal 2-60. The proposed change to § 25.785 is related to a proposed amendment to § 25.785 that is contained in Airworthiness Review Program, Notice No. 8: Aircraft, Engine, and Propeller Airworthiness, and Procedural Proposals (Notice 75-31; 40 FR 29410; July 11, 1975). The proposed amendment to § 25.785 contained in Notice No. 2 is, therefore, being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75-31. Comments submitted for Proposal 2-60 will be considered at that time.

Proposal 2-61. No unfavorable comments were received on the proposed new § 25.787(c). However, based on a comment received on Proposal 2-111, this proposal has been revised to avoid any implication that lamps will be required in cargo compartments.

Proposal 2-62. Four of the five comments received were in favor of the proposal for § 25.815 that would provide for the approval of an aisle width of less than 12 inches, but not less than 9 inches, in transport airplanes with a passenger seating capacity of 10 or less if the aisle width is substantiated by necessary tests. One commentator requested that the proposal be withdrawn because it would result in a reduction in the margin of passenger safety. The FAA disagrees. Service experience with aircraft certificated with less than a 12 inch aisle width in the past has been satisfactory.

Moreover, the FAA will not certificate transport category aircraft with less than a 12 inch aisle width unless the Administrator finds by necessary test that the narrower aisle is safe.

The proposal is adopted without change.

Proposal 2-63. The proposed change to § 25.831 concerning the temperature and ventilation controls for the crew compartment is related to a proposed amendment to § 25.831 that is contained in Airworthiness Review Program Notice No. 5: Equipment and Systems Proposals (Notice 75-23; 40 FR 23048, May 27, 1975). The proposed amendment to § 25.831 contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75-23. Comments submitted for Proposal 2-63 will be considered at that time.

Proposal 2-64. One commentator recommended that proposed § 25.841(b)(1) be revised to make it clear that the pressure relief function may be combined with the regulating valve. The proposal would delete the requirement that one of the pressure relief valves be a pressure regulating valve, but it would still allow such a design. This was specifically covered in Notice 75-10.

One commentator suggested that the language "passenger or crew compartment" in proposed § 25.841(b)(8) be changed to read "occupiable area in the cabin" to ensure that a pressure sensor is located in the lower deck service compartment. The FAA believes the language "occupiable area in the cabin" does not clarify the proposed requirements. The language "passenger and crew compartment" is not limited to the main deck of the airplane, but includes a lower deck service compartment even though this lower deck service compartment may not be occupied during takeoff and landing. For clarification, the parenthetical "(including upper and lower lobe galleys)" has been added to § 25.841(b)(8) as adopted.

Proposal 2-65. The proposed change to § 25.853 concerning the certification requirements necessary to permit smoking in transport category airplanes is related to a proposed amendment to § 25.853 that is contained in Airworthiness Review Program, Notice No. 8: Aircraft, Engine and Propeller Airworthiness, and Procedural Proposals (Notice 75-31, 40 FR 29410; July 11, 1975). The proposed amendment to § 25.853 contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75-31. Comments submitted for Proposal 2-65 will be considered at that time.

Proposal 2-66. No unfavorable comments were received on the proposal to amend § 25.933(b). Accordingly, the proposal is adopted without substantive change.

Proposal 2-67. A commentator suggested that a cross-reference to § 25.143 should be added to proposed § 25.941. The FAA agrees that the pilot strength limits now set forth in § 25.143 should be referenced in § 25.941 in order to define appropriately what constitutes "exceptional strength on the part of the pilot". Accordingly, a paragraph (c) has been added to proposed § 25.941 for that purpose.

Proposal 2-68. Two commentators agreed with the intent of the proposed § 25.951(a) concerning fuel system design and operation of the auxiliary power unit (APU) but requested that it be withdrawn to allow time to review other Part 25 provisions for applicability to APU installations. The FAA does not believe that a further review of Part 25 should in this case, delay completion of this rulemaking action. However, if the FAA determines that the language "auxiliary power unit" should be specifically set forth in other provisions to avoid misinterpretation, the FAA will take action to clarify these provisions.

One commentator stated that the fuel system for an APU operated on the ground would be unnecessarily subject to the same requirement as the engine fuel system. The FAA does not agree that this is necessary. If certain operating conditions are the same for both the engine fuel system and the APU fuel system, the FAA believes that the requirements during such periods should be the same. The proposal is therefore adopted without substantive change.

Proposal 2-69. One commentator suggested that the language "proof and ultimate factors" in the proposal for new paragraphs (d) and (e) of § 25.979 be revised to be consistent with § 25.301. The FAA agrees that the terminology should be consistent and the section as adopted is reworded to use the term ultimate load.

One commentator questioned whether the design criteria for the pressure fueling system was applicable to fuel tanks and fuel tank vents. The proposed amendment to § 25.979 was not intended to apply to fuel tanks and vents. The section as adopted has been revised to make this clear.

Proposal 2-70. Several commentators questioned the meaning of the term "quick actuation drain valve" in proposed § 25.999(b)(3). The FAA agrees that the term may be subject to misinterpretation and that the provision is complete without the words "quick actuation".

One commentator asserted that the proposed requirement in § 25.999(b)(3) that the drain valve not be damaged in the event of a landing with landing gear retracted was not a proper design specification since damage was beyond the control of the manufacturer. The FAA agrees that the language "so that it will not be damaged" is not proper for this requirement, but the FAA believes that the valve, the location of the valve, or both, can be designed to prevent fuel spillage, assuming that a landing is made with the landing gear retracted. The section as adopted has been revised to clarify this intent.

Proposal 2–71. One commentator suggested that proposed § 25.1027(d) be revised to limit the design consideration to sludge or other foreign matter entering the feathering system from the oil tank. The FAA disagrees. Design consideration and flexibility should not be limited to preventing entry of material into the feathering system. All sources of sludge and foreign matter must be considered since the purpose of the regulation is the safe operation of the propeller feathering system. The proposal, therefore is adopted without substantive change.

Proposal 2–72. One commentator suggested that the word "critical" be added before the language "ground, water, and flight operating conditions" in the proposal for § 25.1041, but no reason was given. As noted in the explanation to this proposal, § 25.1041 contains a general cooling requirement, while §§ 25.1043 and 25.1045 are more specific with respect to the type of operating conditions which must be considered during tests. Critical conditions are included in the test requirements of §§ 25.1043 and 25.1045. However, the FAA believes that cooling provisions must be adequate under all ground, water, and flight operating conditions.

Proposal 2–73. No unfavorable comments were received on the proposal to amend § 25.1091(c)(2). Accordingly, the proposal is adopted without substantive change.

Proposal 2–74. One commentator agreed with the proposal for § 25.1093 but suggested that the proposal be changed to agree with the format of the previous paragraphs. The FAA agrees, and the proposal as adopted has been structured the same as the previous paragraphs.

Proposal 2–75. One commentator objected to the proposed lead-in for § 25.1125 that limited the applicability of the section to reciprocating engines. The FAA does not believe that the requirements of this section are applicable to other than reciprocating engine powered airplanes. While some early turbine powered airplanes have had an ejector installation in the exhaust stream to pull cooling air through the nacelle, the FAA does not consider this to be an exhaust heat exchanger within the meaning of the language of § 25.1125. Therefore, the proposed lead-in for § 25.1125 is adopted without substantive change.

Proposed § 25.1125(a)(3) is withdrawn. For a discussion of the withdrawal, see Proposal 2–29.

Proposal 2–76. A commentator stated that the phrase "automatically controlled with relation to the amount of power produced by the engine" in proposed § 25.1143(d) is not appropriate for all fluid injection systems. The FAA agrees that the phrase is not appropriate for certain turbine engine powered airplanes and that further revision of § 25.1143(d) should be considered. Proposed § 25.1143(d) has therefore been withdrawn for further study.

No unfavorable comment was received concerning proposed § 25.1143(e) and this paragraph has been adopted without substantive change.

Proposal 2–77. No unfavorable comments were received on the proposal to add a new § 25.1167. Accordingly, the proposal is adopted without substantive change.

Proposal 2–78. No unfavorable comments were received on the proposal to amend § 25.1197(a). Accordingly, the proposal is adopted without substantive change.

Proposal 2–79. One commentator suggested that proposed § 25.1303(a)(2) be revised to clarify the method of clock indication which would be permitted under the regulation. The FAA agrees that the intent of the proposal was only to recognize the development of accurate digital clocks and that the minimum information presented should be the same. Proposed §§ 25.1303(a)(2) and 29.1303(d) as adopted are revised to make this clear.

Proposal 2-80. Several commentators suggested that the proposed change to § 25.1305 be revised to except anti-detonant injection (ADI) systems from the powerplant instrument proposal for fluid augmentation systems. The commentators expressed the opinion that the proposal for § 25.1143(d) concerning automatic controls for fluid injection systems (other than fuel) eliminated the need for a powerplant instrument for the ADI system. The FAA believes that the flight crew should be able to monitor the proper functioning of any fluid system that is used for thrust or power augmentation and the section as adopted is applicable to ADI systems. However, the section has been clarified to ensure application only to fluids systems that are used for thrust or power augmentation.

Proposal 2-81. No unfavorable comments were received on the proposal to amend § 25.1309. Accordingly, the proposal is adopted without substantive change.

Proposal 2-82. One commentator questioned the proposed color standardization of warning, caution, and advisory lights in new § 25.1322. The commentator stated "arbitrary standards for specific light colors cannot always be stated" because of the design objective to minimize red lights that require immediate crew action and of the need to consider past experience, test, crew acceptance, and the specific application. The FAA agrees that considerations other than the need for standardization of light colors may dominate in special circumstances, and the section as adopted provides for approval by the Administrator of light colors that are different than the standard. As stated by the commentator and in the section as adopted, a design objective is to have red warning lights only if a hazard is to be indicated which may require immediate corrective action.

One commentator noted that the language "warning light" is used in other sections of the regulations, such as § 25.812(e)(2), and a hazard which may require immediate corrective action will not be indicated. The FAA does not agree; the light noted in § 25.812(e)(2) should be red in future designs unless otherwise approved by he Administrator. The FAA believes that in other sections, if the language "warning light" is used, it is consistent with proposed new § 25.1322. However, if the language "warning light" is determined to be not generally applicable, later rulemaking action can be instituted.

One commentator suggested a clarification of the lead-in of the proposal to limit its applicability to lights installed in the cockpit as indicated in the explanation to the proposal. The FAA agrees, and the lead-ins of §§ 23.1322, 25.1322, 27.1322, and 29.1322 have been clarified.

Also see Proposal 2-34 for a discussion of the withdrawal of the blue light proposal.

Proposal 2-83. For comments related to the deferral of proposed § 25.1325(g), see Proposal 2-35.

Proposal 2-84. The proposed change to § 25.1329 concerning the redesignation of § 25.1329 as § 25.1311 and the addition of provisions for automatic flight control systems is related to a proposed amendment to § 25.1329 that is contained in Airworthiness Review Program, Notice No. 5: Equipment and Systems Proposals (Notice 75-23; 40 FR 23048, May 27, 1975). The proposed amendment to § 25.1329 contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75-23. Comments submitted for Proposal 2-84 will be considered at that time.

Proposal 2-85. Proposed § 25.1331(a)(2) concerning instruments using a power supply is related to proposed amendments to §§ 25.1331 and 25.1333 that are contained in Airworthiness Review Program, Notice No. 5: Equipment and Systems Proposals (Notice 75-23; 40 FR 23048; May 27, 1975). The proposed amendment to § 25.1331(a)(2) contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposals in Notice 75-23. Comments submitted for Proposal 2-85 will be considered at that time.

Proposal 2-86. Proposed § 25.1337(a) concerning auxiliary power unit instrument lines is related to a proposed amendment to § 25.1337(a) that is contained in Airworthiness Review Program, Notice No. 3: Powerplant Proposals (Notice 75-19; 40 FR 21866; May 19, 1975). The proposed amendment to § 25.1337(a) contained in Notice No. 2 is therefore deferred until final rulemaking action is taken with respect to the related proposal in Notice 75-19. Comments submitted for Proposal 2-86 will be considered at that time.

Proposal 2-87. Proposed § 25.1353(c)(5) is related to a proposed amendment to § 25.1585 that is contained in Airworthiness Review Program, Notice No. 6: Flight Proposals (Notice 75-25; 40 FR 24664; June 9, 1975). The proposed amendment to § 25.1353(c)(5) contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75-25. Comments submitted for Proposal 2-87 will be considered at that time.

Proposal 2-88. No unfavorable comments were received on the proposal to amend § 25.1355(c). Accordingly, the proposal is adopted without substantive change.

Proposal 2-89. Several commentators suggested that the list of factors to consider for locating forward and rear position lights in proposed §§ 23.1385, 25.1385, 27.1385, and 29.1385 was incomplete.

Two commentators, also suggested that proposed §§ 23.1385(c) and 25.1385(c) be revised to permit a new position light to be installed on each wing tip. The FAA agrees that further study is necessary to develop factors of general applicability for position lights on all aircraft but that a rear position light as far aft as practical on each wing tip of an airplane is a reasonable alternative location. Accordingly, proposed §§ 23.1385(c) and 25.1385(c) have been revised. The proposals concerning the list of factors to be considered for locating forward and rear position lights in § 25.1385 and paralleled in proposed §§ 23.1385, 27.1385, and 29.1385 are withdrawn. However, the deletion of the passing light requirement from current § 25.1385(e) will be made.

Proposal 2-90. One commentator asserted that proposed new § 25.1403 was an operating requirement, not an airworthiness requirement and therefore was not appropriate for Part 25. Although a similar requirement currently exists in § 121.341(b), the FAA believes that such a requirement should be applicable to all newly certificated transport category airplanes.

Two commentators pointed out that the proposal differs from § 121.341(b) in that the proposal was not limited to the area of the wings that are critical from the standpoint of ice accumulation. The FAA agrees, and the section as adopted has been revised accordingly.

A comment was also received that expressed the belief that under the proposal, illumination or other means of ice detection would not be necessary if the wing was shown to have acceptable ice accumulation characteristics. The FAA does not agree. Unless an operating limitation prohibits operations at night in known or forecast icing conditions, the means set forth are required.

Proposal 2-91. Several commentators said that the proposed change to § 25.1439(b)(2)(ii) concerning standards for masks and eye coverings was premature in view of the current testing being conducted on this type of equipment by the FAA. The FAA agrees that this proposed amendment is premature, and new standards are being considered for a later rulemaking action. The proposed change to § 25.1439(b)(2)(ii) is therefore withdrawn.

No favorable comments were received on the proposal to amend paragraph (a) of § 25.1439. Accordingly, the proposal is adopted without substantive change.

Proposal 2-92. No unfavorable comments were received on the proposal to amend § 25.1515. Accordingly, the proposal is adopted without substantive change.

Proposal 2-93. No unfavorable comments were received on the proposal to amend the heading of § 25.1533 and on the proposal to amend § 25.1533(a). Accordingly, this amendment is adopted without substantive change. For comments related to the withdrawal of the proposed new § 25.1533(c), see Proposal 2-49.

Proposal 2-94. The proposed change to § 25.1549 concerning the marking requirements for powerplant instruments is related to a proposed amendment to § 25.1549 that is contained in Airworthiness Review Program, Notice No. 3: Powerplant Proposals (Notice 75-19; 40 FR 21866; May 19, 1975). The proposed amendment to § 25.1549 contained in Notice No. 2 is therefore deferred until final rulemaking action is taken with respect to the related proposal in Notice 75-19. Comments submitted for Proposal 2—94 will be considered at that time.

Proposal 2-95. One commentator took exception to the proposed deletion of the requirement for marking fuel and oil tank capacities at the filler openings in § 25.1557(b). The FAA believes this method of providing the usable fuel tank capacity and the oil tank capacity is no longer necessary. The pilot has the fuel quantity gage and the Airplane Flight Manual, and the servicing personnel usually have no interest in the usable fuel tank capacity. The determination of oil level in oil tanks is usually accomplished with the dipstick. Accordingly, the proposal is adopted without substantive change.

Proposal 2-96. The proposed change to § 25.1581 concerning the Airplane Flight Manual is related to proposed amendment § 25.1581 that is contained in Airworthiness Review Program, Notice No. 6: Flight Proposals (Notice 75-25; 40 FR 24664; June 9, 1975). The proposed amendment to § 25.1581 contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75-25. Comments submitted for Proposal 2-96 will be considered at that time.

Proposal 2-97. No unfavorable comments were received on the proposal to amend § 25.1583. Accordingly, the proposal is adopted without substantive change.

Proposal 2-98. The proposed change to § 25.1587 concerning performance information is related to a proposed amendment to § 25.1587 that is contained in Airworthiness Review Program, Notice No. 6: Flight Proposals (Notice 75-25; 40 FR 24664; June 9, 1975). The proposed amendment to § 25.1587 contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75-25. Comments submitted for Proposal 2-98 will be considered at that time.

Proposal 2-99. Two commentators questioned the applicability of proposed § 27.25(c) concerning a total weight that was greater than the maximum weight established under § 27.25(a) and noted that a clarification of the applicable flight requirements was needed. The FAA agrees that proposed § 27.25(c) should be clarified. Proposed §§ 27.25(c) and 29.25(c) are intended to provide only a total weight standard for approving the rotorcraft structure for rotorcraft that will be operated under Part 133. Proposed §§ 27.25(c) and 29.25(c) as adopted have been revised to clarify this intent.

Proposal 2-100. Proposed § 27.65(a)(2)(i) concerning climb gradients for rotorcraft other than helicopters is related to a proposed new § 27.1587(b)(3) that is contained in Airworthiness Review Program, Notice No. 2: Miscellaneous Proposals (Notice 75-10; 40 FR 10802; March 7, 1975). The proposed amendment to § 27.1587 contained in Notice 75-10 is being deferred; see Proposal 2-140. Therefore, the proposed amendment to § 27.65 contained in Notice 75-10 is also deferred until final rulemaking action is taken with respect to the related proposal for § 27.1587. Comments submitted for Proposal 2-100 will be considered at that time.

Proposal 2-101. No unfavorable comments were received on the proposal to amend § 27.141. Accordingly, the proposal is adopted without substantive change.

Proposal 2-102. No unfavorable comments were received on the proposal to amend § 27.173(a). Accordingly, the proposal is adopted without substantive change.

Proposal 2-103. No unfavorable comments were received on the proposal to amend § 27.175(d)(2)(iv). Accordingly, the proposal is adopted without substantive change.

Proposal 2-104. No unfavorable comments were received on the proposal to amend § 27.321(a). Accordingly, the proposal is adopted without substantive change.

Proposal 2-105. No unfavorable comments were received on the proposal to amend § 27.339. Accordingly, the proposal is adopted without substantive change.

Proposal 2-106. Two commentators suggested that the limit pilot torque for rotorcraft twist controls in proposed §§ 27.397(b)(2) and 29.397(b)(2) should be 80 times the radius (R) in inches instead of 133 inch-pounds, as proposed. The FAA agrees that the pilot torque load requirements should be a function of the radius (R). Also the FAA does not expect the radius (R) of any twist control installed on any rotorcraft type certificated in the future to be greater than 133/80 inches. Therefore, the proposals as adopted revise the limit pilot torque load to 80R inch-pounds.

Proposal 2-107. No unfavorable comments were received on the proposal to add a new § 27.563. Accordingly, the proposal is adopted without substantive change.

Proposal 2-108. No unfavorable comments were received on the proposal to amend § 27.603. Accordingly, the proposal is adopted without substantive change.

Proposal 2-109. One commentator disagreed with proposed §§ 27.685(a) and 29.685(a) that would require the consideration of the effects of the freezing of moisture on control systems since §§ 27.685(a) and 29.685(a) currently require that control systems be designed to prevent jamming. While the explanation for this proposal indicated that the freezing of moisture was a common cause of control jamming, the proposal is also directed at preventing chafing and interference caused by the freezing of moisture. Accordingly, the proposals are adopted without substantive change.

Proposal 2-110. No unfavorable comments were received on the proposal to add a new § 27.733(c). Accordingly, the proposal is adopted without substantive change.

Proposal 2-111. Based on a comment received, the proposed change to § 27.787 has been revised to avoid any implication that lamps will be required in cargo compartments.

Proposal 2-112. No unfavorable comments were received on the proposal to add a new § 27.801. Accordingly, the proposal is adopted without substantive change.

Proposal 2-113. Several commentators stated that the ditching emergency exit standards proposed for §§ 27.807(d) and 29.807 should not be applicable to all rotorcraft. The commentators noted that the new standards would unnecessarily penalize rotorcraft that would never be involved in a ditching situation. The FAA agrees that certain rotorcraft may not operate in areas where ditching is a concern. Compliance with the ditching emergency exit standards should not be required for all rotorcraft during type certification. Therefore, the proposals as adopted have been revised to make it applicable only to rotorcraft for which ditching certification is requested. The overhead hatch requirements proposed in new §§ 27.807(d)(2) and 29.807(d)(3) are withdrawn because of the possible hazards associated with a turning main rotor. In addition, the reference in proposed § 27.807(d) to § 27.807(a) has been deleted as unnecessary, and the reference in proposed § 29.807(d) to § 29.807(c) has been deleted as inappropriate.

Proposal 2-114. For comments related to the proposed amendment of § 27.853, see Proposal 2-18.

Proposal 2-115. Upon further FAA review proposed §§ 27.865(a) and 29.865(a) concerning external load attaching means have been revised to preclude the necessity of considering the application of an external load at angles that will not be obtained in service. One commentator objected to the requirement for a manual mechanical control for the quick-release device. The commentator stated that this requirement was too restrictive due to the other standby electrical systems available. The FAA does not agree. Contrary to the commentator's contention the reliability of controls other than manual mechanical controls have not been sufficiently substantiated to permit their use in place of an manual mechanical control.

Proposal 2-116. One commentator objected to the proposals to add new standards concerning turbine engine installations to §§ 27.903 and 29.903 that would be substantively identical to proposed § 23.903(b). The commentator requested that the proposals be withdrawn since helicopter service experience does not indicate that such a standard is necessary and due consideration has not been given to the differences between helicopter and airplane engine control systems. The FAA disagrees. While there are differences between helicopter and airplane engine installations, the FAA believes that the proposals would provide general design requirements relating to engine operating limitations and engine installation requirements and that these engine installation requirements should be paralleled in Parts 23, 27, and 29. Also see Proposal 2-19.

Proposal 2-117. For comments concerning proposed § 27.917(d), see Proposal 2-163.

Proposal 2-118. The proposed change to § 27.927 concerning the torque transmission test is related to a proposed amendment to § 27.927 that is contained in Airworthiness Review Program, Notice No. 3: Powerplant Proposals (Notice 75-19; 40 FR 21866; May 19, 1975). The proposed amendment to § 27.927 contained in Notice No. 2 is therefore deferred until final rulemaking action is taken with respect to the related proposal in Notice 75-19. Comments submitted for Proposal 2-118 will be considered at that time.

Proposal 2-119. No unfavorable comments were received on the proposal to add a new § 27.939(c). Accordingly, the proposal is adopted without substantive change.

Proposal 2-120. No unfavorable comments were received on the proposal to amend § 27.977. Accordingly, the proposal is adopted without substantive change.

Proposal 2-121. Two commentators objected to the proposals to amend §§ 27.999(b) and 29.999(b) to require the installation of quick actuation type drain valves that are readily accessible, which can be easily opened and closed, and is either located or protected so that it will not be damaged in the event of a landing with landing gear retracted. The commentators stated that the requirement to include crash landing consideration is not considered appropriate since there are a great number of other areas which must be covered in crash landing conditions. The proposals, however, would require that the fuel system drain valves be either located or protected so that it will not be damaged in the event of a landing with landing gear retracted. There are no requirements in the proposal for consideration of crash landing conditions.

In consideration of comments discussed under Proposals 2-26, and 2-70, §§27.999(b)(3)(ii) and 29.999(b)(3)(ii), as adopted, have been clarified to more specifically provide a design consideration.

See Proposals 2-26 and 2-70.

Proposal 2-122. No unfavorable comments were received on the proposal to amend § 27.1043(c). Accordingly, the proposal is adopted without substantive change.

Proposal 2-123. No unfavorable comments were received on the proposal to add a new § 27.1093(c). The proposal as adopted has been editorially changed to agree with the format of the current section.

Proposal 2-124. No unfavorable comments were received on the proposal to add a new § 27.1123. Accordingly, the proposal is adopted without substantive change.

Proposal 2-125. No unfavorable comments were received on the proposal to add a new § 27.1143(d), and the proposal is adopted without substantive change. However, the heading of § 27.1143 has been amended to reflect the contents of the section after the adoption of a new paragraph (d).

Proposal 2-126. No unfavorable comments were received on the proposal to amend § 27.1185. Accordingly, the proposal is adopted without substantive change.

Proposal 2-127. For comments related to proposed amendment of § 27.1322, see Proposals 2-34 and 2-82.

Proposal 2-128. The proposed change to § 27.1325 concerning the static pressure sources is related to a proposed amendment to § 27.1325 that is contained in Airworthiness Review Program, Notice No. 5: Equipment and Systems. Proposals (Notice 75-23; 40 FR 23048; May 27, 1975). The proposed amendment to § 27.1325 contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75-23. Comments submitted for Proposal 2-128 will be considered at that time.

Proposal 2-129. The proposal for a new § 27.1329 concerning the standards for automatic pilot systems is related to a proposed new § 27.1311 that is contained in Airworthiness Review Program, Notice No. 5: Equipment and System Proposals (Notice 75-23; 40 FR 23048; May 27, 1975). The proposal for § 27.1329 contained in Notice No. 2 is therefore being deferred until final rulemaking is taken with respect to the related proposal in Notice 75-23. Comments for Proposal 2-129 will be considered at that time.

Proposal 2-130. No unfavorable comments were received on the proposal to amend § 27.1351. Accordingly, the proposal is adopted without substantive change.

Proposal 2-131. Proposed § 27.1353(f) concerning nickel-cadmium batteries is related to a proposed amendment to § 27.1581 that is contained in Airworthiness Review Program, Notice No. 6: Flight Proposals (Notice 75-25; 40 FR 24664; June 9, 1975). The proposed amendment to § 27.1353(f) contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75-25. Comments submitted for Proposal 2-131 will be considered at that time.

Proposal 2-132. For comments related to the proposed amendment of § 27.1385 and the withdrawal of the proposal, see Proposal 2-89.

Proposal 2-133. No unfavorable comments were received on the proposal to amend § 27.1411. Accordingly, the proposal is adopted without substantive change.

Proposal 2-134. No unfavorable comments were received on the proposal to amend § 27.1415(b). Accordingly, the proposal is adopted without substantive change.

Proposal 2-135. The proposed change to § 27.1545 concerning the V_{ne} requirements is related to a proposed amendment to § 27.1505 that is contained in Airworthiness Review Program, Notice No. 6: Flight Proposals (Notice 75-25; 40 FR 24664; June 9, 1975). The proposed amendment to § 27.1545 contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75-25. Comments submitted for Proposal 2-135 will be considered at that time.

Proposal 2-136. For comments related to the proposed amendment of § 27.1549, see Proposal 2-42.

Proposal 2-137. No unfavorable comments were received on the proposal to amend § 27.1555(c). Accordingly, the proposal is adopted without substantive change.

Proposal 2-138. No unfavorable comments were received on the proposal to amend § 27.1557(c). Accordingly, the proposal is adopted without substantive change.

Proposal 2-139. The proposed change to § 27.1581 concerning the Airplane Flight Manual is related to a proposed amendment to § 27.1581 that is contained in Airworthiness Review Program, Notice No. 6: Flight Proposals (Notice 75-25; 40 FR 24664; June 9, 1975). The proposed amendment to § 27.1581 contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75-25. Comments submitted for Proposal 2-139 will be considered at that time.

Proposal 2-140. The proposed change to § 27.1587 is related to a proposed amendment to § 27.1581 that is contained in Airworthiness Review Program, Notice No. 6: Flight Proposals (Notice 75-25; 40 FR 24664; June 9, 1975). The proposed amendment to § 27.1587 contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75-25. Comments submitted for Proposal 2-140 will be considered at that time.

Proposal 2-141. One commentator suggested that the proposed new § 29.25(c) provisions be limited to category B rotorcraft. However no reason for the suggestion was stated. The FAA knows of no reason why the proposed provisions should be limited to category B rotorcraft. One commentator questioned the applicability of proposed new § 29.25(c) and noted that a clarification of the applicable flight requirements was needed. For discussion of this and other comments related to the proposed new § 29.25(c), see Proposal 2-99.

Proposal 2-142. No unfavorable comments were received on the proposal to amend § 29.63. Accordingly, the proposal is adopted without substantive change.

Proposal 2-143. Several commentators recommended that § 29.67(a)(1) be revised by adding the term "at V_{TOSS}" following the words "feet per minute", and by deleting the phrase "without ground effect". Although paragraph (a)(1)(iv) of § 29.67 as proposed defines the speed to be used in meeting the climb requirements of § 29.67(a)(1) as the takeoff safety speed, the FAA does not believe that the term "V_{TOSS}" is appropriate. Also the FAA does not agree that the phrase "without ground effect" should be deleted from § 29.67(a)(1). The FAA requires that all climb performance be conducted outside the influence of ground effect. Accordingly, the proposal is adopted without substantive change.

Proposal 2-144. No unfavorable comments were received on the proposal to amend § 29.71. Accordingly, the proposal is adopted without substantive change.

Proposal 2-145. No unfavorable comments were received on the proposal to amend § 29.75(b)(2). Accordingly, the proposal is adopted without substantive change.

Proposal 2-146. No unfavorable comments were received on the proposal to amend § 29.141. Accordingly, the proposal is adopted without substantive change.

Proposal 2-147. No unfavorable comments were received on the proposal to amend § 29.173(a). Accordingly, the proposal is adopted without substantive change.

Proposal 2-148. No unfavorable comments were received on the proposal to amend § 29.175(d)(2)(iv). Accordingly, the proposal is adopted without substantive change.

Proposal 2–149. For comments related to the proposed amendment of § 29.397, see Proposal 2–106.

Proposal 2–150. No unfavorable comments were received on the proposal to add a new § 29.563. Accordingly, the proposal is adopted without substantive change.

Proposal 2–151. No unfavorable comments were received on the proposal to amend § 29.603. Accordingly, the proposal is adopted without substantive change.

Proposal 2–152. For comments related to the proposed amendment of § 29.685(a), see Proposal 2–109.

Proposal 2–153. No unfavorable comments were received on the proposal to add a new § 29.733(c). Accordingly, the proposal is adopted without substantive change.

Proposal 2–154. The proposed change to § 29.783 concerning the requirements applicable to "airstair doors" in transport category rotorcraft is related to proposed amendments to § 25.783 that are contained in Airworthiness Review Program, Notice No. 2: Miscellaneous Proposals (Notice 75–10; 40 FR 10802; March 7, 1975) and in Airworthiness Review Program, Notice No. 8: Aircraft, Engine, and Propeller Airworthiness, and Procedural Proposals (Notice 75–31; 40 FR 29410; July 11, 1975). The proposed amendment to § 25.783 contained in Notice 75–10 is being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75–31. The proposed amendment to § 29.783 contained in Notice 75–10 is therefore being deferred until final ruelmaking action is taken with respect to the related proposal for § 25.783. Comments submitted for Proposal 2–154 will be considered at that time.

Proposal 2–155. No unfavorable comments were received on the proposed new § 29.787(d). However, based on a comment received on Proposal 2–111, this proposal has been revised to avoid any implication that lamps will be required in cargo compartments.

Proposal 2–156. No unfavorable comments were received on the proposal to add a new § 29.801. Accordingly, the proposal is adopted without substantive change.

Proposal 2–157. For comments related to the proposed amendment § 29.807, see Proposal 2–113.

Proposal 2–158. No unfavorable comments were received on the proposal to add a new § 29.813(c). Accordingly, the proposal is adopted without substantive change.

Proposal 2–159. One commentator objected to the proposed change to § 29.815 for the same reasons as presented for the proposed change to § 25.815. The discussion of § 25.815 in Proposal 2–62 deals with this comment.

Proposal 2–160. For comments related to the proposed amendment of § 29.853, see Proposal 2–18.

Proposal 2–161. For comments related to the proposed new § 29.865, see Proposal 2–115.

Proposal 2–162. No unfavorable comments were received on the proposal to amend § 29.903(c)(1). Accordingly, the proposal is adopted without substantive change. For comments related to the proposal to add new standards concerning turbine engine installation, see Proposals 2–19 and 2–116.

Proposal 2–163. The only public comment received in response to proposed §§ 27.917(d) and 29.917(a) recommended that the present language in § 29.917(a) be used but gave no reason for the recommendation. The FAA believes that there should be a positive description of the cooling fans that must be considered as part of the rotor drive system. Accordingly, the proposals are adopted without substantive change.

Proposal 2–164. The proposed change to § 29.927 concerning the torque transmission test time is related to a proposed amendment to § 29.927 that is contained in Airworthiness Review Program, Notice No. 8: Aircraft, Engine, and Propeller Airworthiness, and Procedural Proposals (Notice 75–31; 40 FR 29410, July 11, 1975). The proposed amendment to § 29.927 contained in Notice No. 2 is therefore deferred until final rulemaking section is taken with respect to the related proposal in Notice 75–31. Comments submitted for Proposal 2–164 will be considered at that time.

Proposal 2–165. No unfavorable comments were received on the proposal to amend § 29.931. Accordingly, the proposal is adopted without substantive change.

Proposal 2-166. No unfavorable comments were received on the proposal to add a new § 29.939(c). Accordingly, the proposal is adopted without substantive change.

Proposal 2-167. No unfavorable comment was received on the proposal to amend § 29.951(a). Accordingly, the proposal is adopted without substantive change. Also see proposal 2-68.

Proposal 2-168. No unfavorable comments were received on the proposal to amend § 29.997. Accordingly, the proposal is adopted without substantive change.

Proposal 2-169. Based on comments concerning proposed changes to § 25.979, proposed new paragraphs (d) and (e) of § 29.979 have also been revised. See Proposal 2-69 for a discussion of the amendment to § 25.979.

Proposal 2-170. One commentator objected to the proposal to § 29.999 on the basis that the helicopter accident records do not show "any great number due to operators not draining fuel sumps." The FAA believes that this low accident rate due to water contamination in the fuel exists because most helicopters already use quick actuation drain valves.

On commentator questioned the need for proposed § 29.999(b) noting that current § 29.971(d) appears to have the same requirement. The FAA agrees that current § 29.971(d) would be redundant for fuel tank sump drains and has therefore deleted the standards for the fuel tank slump drain in § 29.971(d).

The fuel drain standards in § 29.999(b) as proposed are applicable to each drain required by § 29.999(a) including the drains prescribed in § 29.971, but to avoid misinterpretation the section as adopted is clarified to specifically note the fuel tank sump drains prescribed in § 29.971.

Also see Proposals 2-26, 2-70, and 2-121.

Proposal 2-171. One commentator stated that proposed § 29.1041(a) should be revised to except "ground use only" auxiliary power units (APU's). The FAA disagrees. APU's that are permitted to operate only on the ground have inadvertently continued to operate in flight. Safe operation of APU's requires consideration of ground, water, and flight operating conditions. The proposal is therefore, adopted without substantive change.

Proposal 2-172. No unfavorable comments were received on the proposals to amend § 29.1043(c). Accordingly, the proposal is adopted without substantive change.

Proposal 2-173. No unfavorable comments were received on the proposal to add a new § 29.1093(c). The proposal as adopted has been editorially changed to agree with the format of the current section.

Proposal 2-174. For comments related to the proposed amendment of § 29.1125, see Proposals 2-29 and 2-75.

Proposal 2-175. No unfavorable comment was received on the proposal to amend § 29.1143 and the proposal is adopted without substantive change. However, the heading of § 29.1143 has been amended to reflect the contents of the section after the addition of a new paragraph (e).

Proposal 2-176. No unfavorable comments were received on the proposal to amend § 29.1165(f). Accordingly, the proposal is adopted without substantive change.

Proposal 2-177. Two commentators objected to the selective use of Part 33 requirements in the proposal for a new § 29.1167 that would provide substantiation requirements for accessory gearboxes that are not certificated as part of an engine. The FAA proposed to amend Part 29 like Part 25 for consistency. The FAA now believes that the proposed new § 29.1167 is inappropriate in view of the requirements to substantiate the rotor drive system including gearboxes under the rotor drive system endurance test requirements. Therefore, proposed new § 29.1167 is withdrawn.

Proposal 2-178. No unfavorable comments were received on the proposal to amend § 29.1189(a). Accordingly, the proposal is adopted without substantive change.

Proposal 2-179. No unfavorable comments were received on the proposal to amend § 29.1197(a). Accordingly, the proposal is adopted without substantive change.

Proposal 2-180. For comments related to the proposed amendment of § 29.1303(d), see Proposal 2-79.

Proposal 2–181. No unfavorable comments were received on the proposal to amend § 29.1307. Accordingly, the proposal is adopted without substantive change.

Proposal 2–182. For comments related to proposed amendment of § 29.1322, see Proposals 2–34 and 2–82.

Proposal 2–183. For comments related to the deferral of proposed § 29.1325, see Proposal 2–35.

Proposal 2–184. The proposed change to § 29.1329 concerning automatic pilot systems is related to a proposed new § 29.1311 that is contained in Airworthiness Review Program, Notice No. 5: Equipment and Systems Proposals (Notice 75–23; 40 FR 23048; May 27, 1975)). The proposal for § 29.1329 contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75–23. Comments submitted for Proposal 2–184 will be considered at that time.

Proposal 2–185. The proposed change to § 29.1337 concerning the auxiliary power unit instrument lines is related to a proposed amendment to § 29.1337 that is contained in Airworthiness Review Program, Notice No. 3: Powerplant Proposals (Notice 75–19; 40 FR 21866, May 19, 1975). The proposed amendments to § 29.1337 contained in Notice No. 2 is therefore deferred until final rulemaking action is taken with respect to the related proposal in Notice 75–19. Comments submitted for Proposal 2–185 will be considered at that time.

Proposal 2–186. Proposed § 29.1353(c)(5) concerning nickel-cadium batteries is related to a proposed amendment to § 29.1585 that is contained in Airworthiness Review Program, Notice No. 6: Flight Proposals (Notice 75–25; 40 FR 24664; June 9, 1975). The proposed amendment to § 29.1353(c)(5) contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75–25. Comments submitted for Proposal 2–186 will be considered at that time.

Proposal 2–187. For comments related to the proposed amendment of § 29.1385 and the withdrawal of the proposal, see Proposal 2–89.

Proposal 2–188. The proposal for § 29.1545 concerning the V_{ne} requirements is related to a proposed amendment to § 29.1505 that is contained in Airworthiness Review Program, Notice No. 6: Flight Proposals (Notice 75–25; 40 FR 24664; June 9, 1975). The proposed amendment to § 29.1545 contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75–25. Comments submitted for Proposal 2–188 will be considered at that time.

Proposal 2–189. For comments related to the proposed amendment of § 29.1549, see Proposal 2–42.

Proposal 2–190. No unfavorable comments were received on the proposal to amend § 29.1555(c). Accordingly, the proposal is adopted without substantive change.

Proposal 2–191. No unfavorable comments were received on the proposal to amend § 29.1557(c). Accordingly, the proposal is adopted without substantive change.

Proposal 2–192. The proposed change to § 29.1581 concerning the Airplane Flight Manual is related to a proposed amendment to § 29.1581 that is contained in Airworthiness Review Program, Notice No. 6: Flight Proposals (Notice 75–25; 40 FR 24664; June 9, 1975). The proposed amendment to § 29.1581 contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75–25. Comments submitted for Proposal 2–192 will be considered at that time.

Proposal 2–193. No unfavorable comments were received on the proposal to amend § 31.1. Accordingly, the proposal is adopted without substantive change.

Proposal 2–194. No unfavorable comments were received on the proposal to amend §§ 31.11 and 31.20. Accordingly, the proposal is adopted without substantive change.

Proposal 2–195. No unfavorable comment was received on the proposal to add a new § 31.14 concerning weight limits of manned free balloons. Therefore, the section is adopted without substantive change.

Proposal 2–196. No unfavorable comments were received on the proposal to amend § 31.45. Accordingly, the proposal is adopted without substantive change.

Proposal 2–197. No unfavorable comments were received on the proposal to add a new § 31.46. Accordingly, the proposal is adopted without substantive change.

Proposal 2–198. No unfavorable comments were received on the proposal to amend § 31.63. Accordingly, the proposal is adopted without substantive change.

Proposal 2–199. No unfavorable comments were received on the proposal to amend § 31.85. Accordingly, the proposal is adopted without substantive change.

Proposal 2–200. No unfavorable comments were received on the proposal to amend § 33.1. Accordingly, the proposal is adopted without substantive change.

Proposal 2–201. No unfavorable comments were received on the proposal to amend § 35.1. Accordingly, the proposal is adopted without substantive change.

Proposal 2–202. No unfavorable comments were received on the proposal to amend § 35.39. Accordingly, the proposal is adopted without substantive change.

Proposal 2–203. No unfavorable comments were received on the proposal to amend § 35.41(e). Accordingly, the proposal is adopted without substantive change.

Proposal 2–204. No unfavorable comments were received on the proposal to amend § 35.45(a). Accordingly, the proposal is adopted without substantive change.

Proposal 2–205. No unfavorable comments were received on the proposal to amend § 91.14. Accordingly, the proposal is adopted without substantive change.

Proposal 2–206. No unfavorable comments were received on the proposal to amend § 91.21(a). Accordingly, the proposal is adopted without substantive change.

Proposal 2–207. One commentator suggested that the proposed change to § 91.33(d)(6) concerning clock requirements should use the language of § 121.305. The FAA believes that a standard should be specified in § 91.33(d)(6) for digital clocks and the proposal as adopted provides a specific standard. See Proposal 2–79.

Proposal 2–208. The intent of the proposed new § 91.193(g) is to require protective breathing equipment that would meet the standards proposed for § 25.1439(b) on certain airplanes operated under Part 91 Subpart D. Based on the current testing being conducted on this type of equipment, the FAA is developing new standards for a later rulemaking action. The proposal for § 25.1439(b)(2)(ii) is being withdrawn (See Proposal 2–91). Therefore, the FAA believes that the proposal for § 91.193 is premature, and the proposal is withdrawn.

Proposal 2–209. Although no unfavorable comment was received on the proposed revision of § 91.209, the FAA believes that revision of similar ice protection provision in § 135.85 may be necessary. Amendments to §§ 91.209 and 135.85 should be considered together. Therefore, the proposed change to § 91.209 is withdrawn.

Proposal 2–210. No unfavorable comments were received on the proposal to amend § 121.171(b). Accordingly, the proposal is adopted without substantive change.

Proposal 2–211. No unfavorable comments were received on the proposal to amend § 121.199. Accordingly, the proposal is adopted without substantive change.

Proposal 2–212. No unfavorable comments were received on the proposal to amend §§ 121.331(b) and 121.333(b). Accordingly, the proposal is adopted without substantive change.

Proposal 2–213. The intent of proposed § 121.337(d) is to require protective breathing equipment that would meet the proposed requirements of § 25.1439(b) installed in certain airplanes operated under Part 121. However, proposed § 25.1439(b)(2)(ii) is withdrawn in this notice. Based on the current testing being conducted on this type of equipment, the FAA is developing new standards for a later rulemaking action. The FAA therefore believes that the proposed change to § 121.337 is premature and the proposal is withdrawn. Also see Proposal 2–91.

Proposal 2–214. No unfavorable comments were received on the proposal to amend § 127.105. Accordingly, the proposal is adopted without substantive change.

Proposal 2–215. No unfavorable comments were received on the proposal to add a new § 127.106. Accordingly, the proposal is adopted without substantive change.

Proposal 2–216. One commentator objected to the proposed amendment to § 133.1. The commentator stated that the proposal specifically eliminates the reference to airworthiness certification rules when, in fact, Subpart D is retained intact except for the standards for external-load attaching means and quick-release devices. The FAA agrees that reference to airworthiness requirements should not be deleted without other changes to Part 133, and the proposal is withdrawn.

Proposal 2-217. One commentator objected to the proposed amendment to § 133.41 (c)(6). However no reason for the objection was stated. The proposal is therefore adopted herein without substantive change.

Proposal 2-218. One commentator requested that proposed § 133.43(a) be revised to provide for the use of external-load attaching means previously approved under Part 133. The FAA agrees and proposed § 133.43 is revised accordingly.

Proposal 2-219. No unfavorable comments were received on the proposal to amend § 133.45(c). Accordingly, the proposal is adopted without substantive change.

Proposal 2-220. No unfavorable comments were received on the proposal to amend § 135.71(a)(5). Accordingly, the proposal is adopted without substantive change.

Proposal 2-221. Based upon further review by the FAA proposed § 135.165(b)(2) is being withdrawn because contrary to the explanation for the proposal in Notice 75-10, the proposal would result in unjustifiably different standards for transport category airplanes operated under Part 135 and those operated under Part 121.

(Secs. 313(a), 601, 603, 604, and 605 of the Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421, 1423, 1424, and 1425); sec. 6(c) of the Department of Transportation Act (49 U.S.C. 1655(c)).

In consideration of the foregoing, and for the reasons stated in Notice 75-10, Parts 21, 23, 25, 27, 29, 31, 33, 35, 91, 121, 127, 133, and 135 of the Federal Aviation Regulations are amended as follows, effective February 1, 1977.

The Federal Aviation Administration has determined that this document does not contain a major proposal requiring preparation of an Inflation Impact Statement under Executive Order 11821 and OMB Circular A-107.

Amendment 27-12

Airworthiness Review Program—Amendment No. 4: Powerplant Amendments

Adopted: March 10, 1977 **Effective: May 2, 1977**

(Published in 42 FR 15034, March 17, 1977)

The purpose of these amendments is to update and improve the airworthiness standards applicable to the type certification of aircraft engines and propellers and of aircraft with respect to the provisions relating to powerplant installations.

These amendments are the fourth in a series of amendments to be issued as part of the Airworthiness Review Program. The following amendments have previously been issued as part of this Airworthiness Review Program:

Title	*FR Citation*
Form number and clarifying revisions.	40 FR 2576; Jan. 14, 1975.
Rotorcraft anticollision lights standards.	41 FR 5290; Feb. 5, 1976.
Miscellaneous amendments.	41 FR 55454; Dec. 20, 1976.

These amendments are based on two Notices of Proposed Rule Making—Notice 75-10 published in the Federal Register on March 7, 1975 (40 FR 10802); and Notice 75-19 published in the Federal Register on May 19, 1975 (40 FR 21866). The amendments based on Notice 75-10 were deferred in the series of amendments titled "Miscellaneous Amendments" (41 FR 55454; Dec. 20, 1976) so that they could be considered in conjunction with the final disposition of certain proposals in Notice 75-19. The discussions of the comments received for the deferred proposals are included under the heading of the related Notice 75-19 proposals.

Interested persons have been afforded an opportunity to participate in the making of these amendments and due consideration has been given to all matter presented. A number of substantive changes and changes of an editorial and clarifying nature have been made to the proposed rules based upon relevant comments received and upon further review within the FAA. Except for the minor editorial and clarifying changes and the substantive changes discussed below, these amendments and the reasons for their adoption are the same as those contained in Notices 75-10 and 75-19.

The following discussion is keyed to the like-numbered proposals contained in Notice 75-19:

Proposal 3-1. In commenting on proposed § 1.1, which would add definitions for "Altitude engine" and "Sea level engine," one commentator suggested that current § 91.33(b)(8) should be revised to require a manifold pressure gauge for each sea level engine equipped with a constant speed propeller, as well as for each altitude engine. The commentator stated that such a sea level engine is capable of being overboosted, if operated with the propeller adjusted for operations at high beta angles and the throttle adjusted for high power. The FAA does not agree since a "Sea level engine" as defined would be capable of producing rated takeoff power only at sea level. Therefore, the definitions of "Altitude engine" and "Sea level engine" are adopted as proposed.

Proposal 3-2. Based upon a further review, proposed new § 23.739 concerning a requirement for landing gear electrical ground connections is withdrawn.

Proposal 3-3. One commentator questioned the proposed amendment of § 23.901(b)(2) concerning easily removable engine cowls and nacelles to facilitate preflight checks. The commentator was of the opinion that the preflight check made by the pilot should be limited to oil level inspection and suggested that the proposal be revised to only require provisions so that the pilot can easily check the level of lubrication oil. The FAA does not agree with the commentator. Items other than the oil level need to be checked in the engine compartment during a preflight check and therefore the engine cowls and nacelles must be easily removable or openable by the pilot to facilitate these checks.

Another commentator objected to the phrase "sustained loss of power" in proposed § 23.901(b)(3), as being insufficiently definitive by prescribing a limit on the duration of power loss rather than the degree of power loss. The commentator suggested the use of the phrase "serious loss of power." The FAA does not agree. The phrase "sustained loss of power is consistent with present § 33.77(c), and was selected since the ingestion of rain can cause a power loss that is acceptable if it is not sustained. The commentator also objected to the prescribed rate of rain ingestion as being more severe than is presently prescribed or proposed for turbine engines in Part 25. The rain ingestion rate of 4 percent of engine airflow by weight is presently prescribed for all turbine engines of new design in § 33.77(f). Contrary to the commentator's contention, proposed § 25.1091(e) would apply the same rate in Part 25 to turbine engine installations using engines type certificated under regulations that did not include the current Part 33 requirement. The FAA believes that the rain ingestion rate is a reasonable certification requirement and is consistent with current § 33.77(f).

The commentator stated further that the moisture content should be that specified in Part 25, Appendix C, or two percent water content by weight. However, Appendix C defines an icing cloud and not a rain condition.

The commentator also stated that sufficient information regarding the collection and recording of the test data has not been provided and would be necessary to meet the requirements. The FAA did not intend to include administrative or type certification procedures in the proposal. No difficulty has been experienced in this regard during the type certification testing of turbine engines and no difficulty is foreseen in applying the proposed requirement.

The proposal is revised editorially for clarity.

Proposal 3–4. No adverse comments were received with respect to proposed deletion of § 23.939(b). The proposal, therefore, is adopted.

Proposal 3–5. No unfavorable comment was received for proposed new § 23.943, and the proposal is adopted without substantive change. See Proposal 3–26 for a discussion of related comments.

Proposal 3–6. No unfavorable comments were received on the proposal to amend § 23.959. Accordingly, the proposal is adopted without substantive change.

Proposal 3–7. In commenting on proposed § 23.967(a)(5) one commentator stated that problems of fatigue of tanks should be examined where a negative pressure could exist in the tank. The proposal covers only bladder cells and the FAA does not regard fatigue considerations to be pertinent to bladder cells. The proposal is editorially revised to ensure that the exception for zero or negative pressure is clear.

Proposal 3–8. For a discussion of comments related to proposed new § 23.973(d), see Proposal 3–31.

Proposal 3–9. Two commentators questioned proposed new § 23.975(a)(7). The commentators stated that the proposal to prevent fuel loss when the airplane is parked in any direction on a ramp having a one-degree slope did not adequately consider the problems of fuel discharged because of thermal expansion. The FAA agrees that the intent of the proposal was to consider normal parking situations but not thermal expansion. The proposal is revised to make that exception.

A commentator stated that proposed § 23.975(a)(8) could be interpreted as meaning that if at least two separate and independent vents are provided, neither has to meet the proposed requirements. The FAA believes the proposal is not clear and may cause a misinterpretation of current § 23.975(a). The proposal is therefore withdrawn.

Several commentators suggested revisions of § 23.975(a)(8). In light of the withdrawal of proposed paragraph (a)(8), these comments are not discussed.

Proposal 3–10. No unfavorable comments were received on the proposal to amend § 23.995. The proposal is revised editorially for clarity. Also see Proposal 3–13.

Proposal 3–11. For a discussion of comments related to proposed § 23.1093(b), see Proposal 3–34.

Proposal 3–12. A commentator objected to proposed § 23.1121(b) concerning the location and shielding of exhaust system parts because of a lack of specificity on how to determine whether the location of a system carrying flammable fluid is acceptable.

The FAA did not intend to state how an acceptable location would be determined since a number of acceptable methods might exist. The commentator also pointed out the possibility that a shield located close to a hot component might become hot enough to ignite flammable fluid. The FAA agrees and proposed §§ 23.1121(b), 25.1121(d), 27.1121(d), and 29.1121(b) have been revised to make it clear that shields used for shielding exhaust system parts are also parts of the exhaust system. The commentator also questioned whether the flammable fluid leak sources to be considered are those around fittings or include those caused by rupture of a fluid carrying line. Proposed § 23.1121(b) covers any leakage from a flammable fluid system, including fluid-carrying lines and fittings, as well as the joints between them. Finally, the commentators stated that consideration should be given to fire detection and extinguishing equipment in showing compliance with proposed § 23.1121(b). The FAA does not agree since it is necessary to take steps to both prevent and control fires.

A commentator stated that proposed § 23.1121(b) would make an adequate design difficult to achieve and contended that the resultant design would be complex with an inherent lower reliability than a simple system. The FAA does not agree. The proposal specifically allows the use of exhaust system shielding as a method of avoiding impingement of flammable fluids. Therefore, the FAA believes the proposal would reduce design difficulties. The commentator also stated that it would be virtually impossible to prove whether the objective of the proposal had been met. The FAA does not foresee any difficulty in administering the requirement.

No unfavorable comments were received on the proposed new § 23.1121(h). Accordingly, the proposal is adopted without substantive change.

Proposal 3–13. A commentator noted that proposed § 23.1141(g)(1) would prohibit the use of a rotary type switch for selecting fuel supply from more than one tank, and suggested that the proposal be revised to read: "For manual valves, positive stops or in the case of fuel valves suitable index provisions, in the open and closed position." The FAA agrees and proposed §§ 23.1141(g)(1), 25.1141(f)(1), 27.1141(c)(1), and 29.1141(f)(1) are revised accordingly.

Several commentators concurred with proposed §§ 23.1141(g)(2) and 25.1141(f)(2) but believed that the pilot might not have a clear picture of the effect of valve position and recommended that the proposal be revised to require means to indicate proper valve operation to the flight crew. Another commentator stated that it is unnecessary to require indication of actual valve position with power-assisted valves and that it would be sufficient to indicate open and closed positions. Proposed §§ 23.1141(g)(2) and 25.1141(f)(2) were not intended to require an indication of the proper functioning of a power-assisted valve or to require an indication of each of the numerous possible valve positions. In addition, the proposal, as stated in the explanation, would recognize the acceptability of intransit light indicators. Therefore, proposed §§ 23.1141(g)(2), 25.1141(f)(2), 27.1141(c)(2), and 29.1141(f)(2) have been revised accordingly.

Proposal 3–14. No unfavorable comment was received on the proposal to amend § 23.1145(c). However, see the discussion of Proposal 3–40 for a revision of proposed § 23.1145(c).

Proposal 3–15. One commentator suggested that proposed § 23.1193(f) be revised to require a "fireproof" standard and to combine it with the fireproof standard for cowlings in current § 23.1193(e). The FAA does not agree since adopting the suggestion would result in an unduly severe provision. The proposal offers the design alternatives for multiengine airplanes with supercharged engines of fireproof nacelle skin or fireproof cowling skin. Furthermore, the proposal is consistent with a similar provision in Part 25.

A second commentator believed that there should be a tradeoff between fire detection and extinguishment requirements. The FAA believes that both this proposal relating to fire containment and Proposal 3–16 relating to fire detection are necessary in light of service experience. The commentator also felt that the proposal should refer only to engines with mechanically driven superchargers and not to all supercharged engines. The FAA disagrees since there have been fires on supercharged engine installations other than those with mechanically driven superchargers and the proposal is applicable to all supercharged multiengine powered airplanes.

Another commentator questioned whether the reference in the proposal to supercharged engines was intended to include engines with turbo-superchargers. The term "supercharged" covers both mechanical and turbo-supercharged engines.

Proposal 3-16. One commentator requested that proposed new § 23.1203 concerning fire detector systems be revised to exclude turbocharged multiengine powered airplanes because these airplanes are not any more susceptible to fire than airplanes with sea level engines. The FAA disagrees. Service experience indicates that multiengine powered airplanes incorporating turbo-superchargers are more susceptible to fires than those that do not incorporate turbo-superchargers.

Another commentator opposed the proposal on the grounds that fire detection systems have not been shown to be necessary for general aviation aircraft and that the emphasis should be placed on fire prevention. The commentator also stated that there has been a history of false fire detection signals that have resulted in unscheduled landings and needless engine shut-downs. The FAA agrees that fire prevention is important and proposals have been made in the Airworthiness Review Program to enhance aircraft fire prevention capabilities. However, there is a need to require fire detection provisions so that early action can be taken if a fire occurs. Also, false fire warnings, associated with early detection systems on transport category airplanes, do not occur to an unacceptable degree in present detector systems which have the benefit of many years of service experience and technical improvements. The proposal is adopted with only minor editorial changes.

Proposal 3-17. For a discussion of the withdrawal of proposed § 23.1305(h), see Proposal 3-59.

For a discussion of comments on proposed § 23.1305(w) concerning fire warning indicators for those airplanes required to comply with § 23.1203, see Proposal 3-16.

Proposal 3-18. One commentator agreed with the intent of the proposal for § 23.1337 (a) concerning powerplant instruments and instrument lines that utilize flammable fluids, but suggested a number of changes to make the provision more specific. The FAA does not agree. Flexibility in the requirement is necessary to avoid creating unnecessary design restrictions. The commentator suggested that a fire extinguisher be specified for compliance with the proposed rule. The FAA does not agree. The intent of the proposal is to prevent the occurrence of a fire hazard.

Another commentator did not concur with the proposal on the grounds that §§ 23.853 (d) and 23.993 adequately cover its intent and it would result in undue crowding in the cockpit area. The FAA disagrees. The proposal contains necessary provisions not covered by § 23.993 and deals with locations not covered by § 23.853(d). In addition, the FAA has no data to indicate that crowding in the cockpit area would result from the proposal.

Proposals 3-19 and 2-44. Proposed § 23.1557(e) was intended to implement the requirement in Proposal 3-2 and is withdrawn because of the withdrawal of that proposal.

Disposition of Proposal 2-44 to amend § 23.1557 (Notice 75-10) was deferred so that it could be considered in connection with Proposal 3-19. No unfavorable comment was received on Proposal 2-44. Accordingly, the proposal is adopted without substantive change.

Proposal 3-20. Based upon a further review, proposed new § 25.739 concerning a requirement for landing gear electrical ground connections is withdrawn.

Proposal 3-21. One commentator suggested that the installation instructions of proposed § 25.901(b)(1)(i) should be limited to those installation design parameters pertinent to the engine type certificate. The installation instructions provided under § 33.5 include only those parameters referred to by the commentator, and the FAA believes that a revision of the proposal is not needed. Also see Proposal 3-51.

Two commentators objected to the use of the term "extremely remote" in proposed § 25.901(c) as not being clearly understood. The FAA believes the term is appropriate since it has been used in other sections of the regulations, without administrative difficulty, to establish the consideration that must be given to the failure of structural components during the evaluation of the type design.

One commentator believes that the proposal would make § 25.1309 inapplicable to powerplant or APU installations. The FAA disagrees; § 25.1309 would continue to apply to powerplant and APU installations.

Another commentator concurred with the proposal if, with respect to APUs, it is limited to those approved for use in flight. The FAA does not believe the proposal should be so limited since the failure or malfunction of an APU approved for use only on the ground could jeopardize safe operation on the ground and in flight. The proposal is adopted without substantive change.

Proposal 3-22. One commentator recommended revising proposed § 25.903(e)(2) to require only the establishment of an envelope that defines the inflight restart capability. The FAA disagrees since this recommendation would not explicitly require restart capability, which was the intent of the proposal and which the FAA believes is essential for safe operation.

Another commentator questioned the deletion of the fire resistant requirement for engine restarting from current § 25.903(c). The FAA believes, due to the very limited use of an engine after a fire in the engine, that the benefit of requiring the components of the restarting system to be fire resistant are slight. The FAA thus can no longer justify this requirement.

A commentator did not concur with proposed § 25.903(e)(3) because it provides for ignition but not for rotational capability sufficient for an engine start. The proposal however was not intended to require a power source for rotation where windmilling speeds are too low for restarting. The proposal would provide the necessary electrical power for engine ignition whether or not the windmilling speed was adequate for an engine start. The proposal is adopted without substantive change.

Proposal 3-23. Several commentators believed the reference in proposed § 25.933(a) to engine idle forward thrust was misleading and that the word "forward" should be deleted. One commentator suggested the word "reverse" be used instead of "forward". However, the direction of the thrust produced by the engine is not pertinent to the proposal. The resultant thrust is controlled by the reverser position. Therefore, the word "forward" is deleted.

One of the commentators believed that the allowable engine thrust setting should be stated as a percent of maximum or in terms of aircraft performance. The commentator suggested "flight idle" be used in place of "idle". The proposal was intended to require the engine thrust to be reduced to the thrust produced at idle in flight and the proposal has been revised to specify flight idle. The same commentator believed the proposal could be interpreted to include the malfunction of all reversers and an unlimited combination of failure modes. The proposed lead-in paragraph (a) is revised to make it clear that consideration must be given to each reverser but only one reversal at a time.

Another commentator recommended that the proposal be revised to require the prevention of inadvertent thrust reversal in flight. The FAA disagrees. Section 25.1155 currently requires consideration of inadvertent operation for each reverse thrust control.

A commentator stated that present § 25.933(d) covers the proposal. The FAA does not agree. Proposed § 25.933(a) would apply to all cases of in-flight thrust reversal of a reverser intended for ground operation only. Section 25.933(d) on the other hand applies only to malfunctions of the thrust reverser system that affect directional control.

Another commentator suggested that the word "condition" at the end of the proposed paragraph (a)(2) should be changed to "position". The FAA agrees that the significant status of the reverser is its position and the proposal is revised accordingly.

Finally, a commentator stated in view of the requirements in § 25.1155, proposed § 25.933(a) should be limited to systems failures. The FAA disagrees. The consequence of an in-flight thrust reversal is the same whether the reversal results from malfunction or the control is moved to the reverse position. Both situations have occurred in service and need consideration. The commentator also suggested replacing "possible" by "probable" in proposed § 25.933(a)(2) because "possible" does not define the limit of failure analysis or test configuration that has to be considered. However, the FAA believes that any degree of deployment of the reverser should be considered.

Proposal 3-24. No unfavorable comment was received on the proposal to delete § 25.939(b) and the proposal is adopted.

Proposal 3-25. One commentator suggested that the heading of proposed new § 25.941 be revised to read "Thrust or power augmentation system" for clarification. The FAA agrees and the heading is revised as suggested. The same commentator also pointed out that the section designation § 25.941 had been used in connection with another proposal in Notice 75-10. The FAA agrees and the section as adopted is designated as § 25.945.

A commentator suggested that proposed § 25.941(b)(2) should be clarified by adding the word "maximum" before the language "operating pressure". The FAA agrees, and the proposal as adopted has been so clarified.

A commentator referring to proposed § 25.941(b)(3), stated that it is not necessary to specify how the venting should be done and suggested that the proposal be revised to require that the venting arrangements for each tank must perform their intended functions under any foreseeable conditions. While the FAA does not agree with the revision suggested by the commentator, the FAA does agree that the vent need not be from the "top" of the expansion space. If the venting is effective under "any normal flight condition" the vent could be located in other places in the expansion space. Proposed § 25.941(b)(3) is revised accordingly to allow the applicant any needed flexibility.

Another commentator on proposed paragraph (b)(3) stated that the proposal would preclude pressurization as a means of pumping. The FAA agrees. The proposal was not intended to preclude pressurization and is revised to apply only to vented tanks.

A commentator suggested a revision of proposed § 25.941(b)(4) that would require marking each tank filler cap to specify "usable tank capacity" rather than tank capacity. However, after further review the FAA does not believe a requirement for marking the cap with "tank capacity" or "usable tank capacity" is necessary and the requirement is deleted from the proposal.

Another commentator thought that placards should be treated separately from system design and that the proposal should be deleted because similar requirements for fuel and oil systems are being considered for deletion. The FAA believes that marking the tank fluid opening to identify the fluid to be used may avoid the inadvertent use of incorrect fluids.

One commentator stated that it is highly probable that the filler cap will not be large enough to indicate the required markings and that markings adjacent to the fluid filler cap should be allowed as is the case for § 25.1557(b). The FAA agrees and paragraph (b)(4) is revised to require marking at or near the filler cover.

On the basis of comments received and upon further review, the FAA believes that adoption of proposed § 25.941(b)(5) is not appropriate at this time and the proposal is withdrawn.

Another commentator believed that the proposal should be combined with § 25.963(e) to cover all fluid tanks. The FAA agrees that current § 25.963(e) should be combined with other augmentation system requirements but does not believe that augmentation system requirements and fuel tank requirements should be combined. Proposed § 25.941 and current § 25.963(e) are combined in a new § 25.945.

Finally, a commentator on the fuel-injection exclusion in proposed paragraph (d) questioned whether water-methanol as used on the Rolls-Royce Model 542 (Dart) would be regarded as a fuel. In the Dart application, the water-methanol system is not regarded as a fuel injection system. Therefore, the water-methanol system used on the Dart engine would not be excluded from the augmentation system requirements of § 25.945.

Proposal 3-26. Several commentators objected to proposed new § 25.943 concerning the effect of negative accelerations on engine and APU operation. One commentator recommended that the word "sustained" be used in place of the word "hazardous" in relation to which malfunctions need be considered under the proposed rules. The FAA disagrees since the significance of a malfunction is whether it is hazardous, irrespective of its duration.

A commentator did not concur with the proposal, stating that a differentiation is necessary between ground-use APUs and other APUs. The commentator apparently misinterpreted the proposal since the proposal explicitly applies to an APU only if it is approved for use in flight.

Two commentators indicated that the proposal should be limited to APUs that are essential to the safety of flight. The FAA does not agree since the malfunction of a nonessential APU approved for use in flight might be hazardous. All flight-use APUs should therefore be evaluated under the proposal.

A commentator stated that since negative acceleration could affect all engines simultaneously, the requirement should refer to "engines". The proposal applies to any engine at any point during the negative acceleration and would necessarily include a determination of the effect of negative acceleration on each engine during the entire acceleration.

One commentator requested information on the duration of acceleration to be considered. The duration of acceleration to be considered under the provision is that expected in service and depends on the maneuver-time history of the particular aircraft type being evaluated within its flight envelope. The proposal is adopted without substantive change.

Proposal 3-27. A commentator objected to the list of factors in proposed § 25.952(a) concerning characteristics that a test article must have that is used to reproduce the general fuel system. The commentator stated that in many cases the list is not complete and therefore may be misleading. Upon further review the FAA agrees that the specific list of characteristics may not be appropriate in all cases. The FAA believes that revision of the proposal to require that the test article must reproduce the operating characteristics of the portion of the fuel system to be tested will allow appropriate flexibility in determining the tests that are necessary and will eliminate the need for the list of factors which are already included within the term "operating characteristics".

Several commentators believed that the proposed § 25.952(b) was too restrictive. One commentator suggested that paragraph (b) be revised to read "The likely failure of any heat exchanger using fuel as one of its fluids may not result in a hazardous condition". The FAA agrees that contamination of either fluid does not always result in a hazardous condition and the requirement need not be as restrictive as proposed. Proposed § 25.952(b) is revised accordingly.

One commentator also commented that proposed paragraph (b) should apply only to heat exchangers that are part of the airplane fuel system and that engine heat exchangers should be controlled by a similar requirement in Part 33. The FAA disagrees. The evaluation whether contamination or other likely failure could cause a hazardous condition can only be determined in a particular airplane installation. Therefore, the proposal is applicable to airplane-furnished and engine-furnished heat exchangers.

Proposal 3-28. One commentator questioned the proposed clarification of § 25.959. While the commentator agreed that unusable fuel supply should be determined under § 25.959 without considering fuel system component failures, the commentator believed that if a failure of a fuel system component would produce a greater amount of unusable fuel that fact must be determined in certification and made known to the operator. Fuel system component failures are not a required consideration under § 25.959. However, if the FAA determines that additional information is necessary for safe operation, this information must be furnished to the operator under the requirements of subpart G of Part 25. Accordingly, the proposal is adopted without substantive change.

Proposal 3-29. One commentator stated that proposed § 25.963(f) did not contain a provision to ensure fuel flow if the regulator failed and that there should be a manual back up for the crew in the event of a system failure. The proposal was not intended to ensure continued fuel flow after a regulator failure. The required fail-safe features are only intended to ensure the prevention of over-pressurization. The FAA, furthermore, does not believe that an additional requirement for a specific manual system has been justified. The proposal is revised to ensure this intent.

Two other commentators believed that an automatic regulating means or a mechanical pressure regulating device need not be required if there are fail-safe features to prevent excessive pressure buildup. The FAA agrees and the proposal is revised to require a means with fail-safe features to prevent the buildup of excessive pressure differential between the inside and outside of the tank.

Proposed § 25.1305(a)(9) concerning powerplant instruments would have required a means to check the operation of the automatic regulating means in proposed § 25.963 (f). Since paragraph (f) as revised would not require a means to regulate fuel tank pressure, an instrument to check this operation should not be required. Therefore, proposed § 25.1305(a)(9) is withdrawn.

See Proposal 3-25 for discussion of the transfer of current § 25.963(e), concerning augmentation liquid tank capacity, to § 25.945(e).

Proposal 3-30. One commentator interpreted § 25.965(d) to mean that only a pressure test is required for non-metallic fuel tanks. The commentator recommended that slosh testing be added to proposed new § 25.965(d) as a requirement for non-metallic tanks in transport category airplanes. The FAA does not agree with the recommendation since § 25.965(c) already requires slosh testing of all non-metallic tanks except where satisfactory experience with a similar tank in a similar installation can be shown.

Two commentators concurred with the proposal but believed the words "analysis or" should be inserted in conjunction with the word "tests" because analysis may be adequate in showing compliance, either alone or when combined with a limited test program. Furthermore, when the tank is an integral tank the structural loading, including aerodynamic loads, is not always amenable to test. The FAA agrees, and the proposal is revised by inserting the words "analysis or" before the word "tests".

Proposal 3-31. Sections 23.973(d) and 25.973(d), as proposed, are identical and concern the electrical bonding of the airplane and fueling equipment.

The FAA agrees with two commentators who stated that where a metal-to-metal bond is made between the airplane and the fueling equipment no need exists for separate electrical bonding of the fuel nozzle to the airplane fueling connection. The FAA believes that considering airplane and ground fueling systems being used today metal-to-metal contact will exist during pressure refueling. Therefore, the proposals are revised to except pressure fueling connection points from the fuel system electrical bonding provision.

Another commentator opposed the proposal on the grounds that there are no statistics to show that the present procedure is unsafe and that requiring special ground connections would increase cost and impose an unnecessary economic burden. The FAA does not concur because the flow rates associated with fueling without proper bonding can induce an electrostatic discharge sufficient to ignite fuel vapor.

A third commentator believed that a review of all fueling procedures should be conducted, in which the subject of grounding points would be one of several subjects to be considered, and that the review should be undertaken before any new rule affecting those procedures is adopted. The FAA agrees that an overall review of fueling procedure and equipment might be desirable; however, the FAA is not aware of any substantive reason to delay the adoption of the proposal with the change discussed above.

Proposal 3-32. No unfavorable comments were received on the proposal to amend § 25.995. Accordingly, the proposal is adopted without substantive change. Also see Proposal 3-39.

Proposal 3-33. One commentator questioned the proposed amendment to § 25.1091. The commentator stated that incorporating APU requirements into the propulsion engine requirements is confusing and unnecessary and that each APU would have to meet the propulsion engine foreign object ingestion test requirements for takeoff, flight idle, and cruise conditions although APUs do not undergo these conditions. The FAA agrees that paragraph (e) should not apply to APUs since foreign object ingestion by APUs is not considered to be a significant problem. However, the FAA believes that applicability of the other requirements to APUs is necessary for the reasons stated in the explanation for the proposal. The commentator also believed that to comply with proposed paragraph (e), the installed engine must repeat the ingestion test requirements of § 33.77. The FAA did not intend to require that the ingestion test requirements be repeated on engines that had already shown compliance with § 33.77. The FAA believes that the test required by § 33.77 during engine type certification adequately accounts for the effects of inlet ingestion on the powerplant installation. Proposed § 25.1091(e) is revised accordingly to apply only to turbine engines and to include only those engines that had not been shown during engine type certification to comply with § 33.77.

Another commentator recommended that proposed paragraph (e) be revised to require each turbine powerplant installation to "be consistent with the foreign object ingestion requirements of § 33.77." The FAA believes that the revised proposal attains the objective of the recommendation. The proposal is adopted with the revisions noted.

Proposal 3-34. Several comments were made on proposed §§ 23.1093 and 25.1093 that did not take into consideration Amendment Nos. 23-15 and 25-36, effective October 31, 1974. Proposals 3-11 and 3-34 proposed only a minor change to make it clear that the requirements of §§ 23.1093(b) and 25.1093(b), concerning ice accumulation caused by the ice and snow expected within the approved flight envelope, cover air inlet system components.

Proposed §§ 23.1093(b), 25.1093(b), 27.1093(b), and 29.1093(b) are modified by inserting the word "operate" in place of the words "function properly" for consistency in terminology with the current §§ 23.1093(b), 25.1093(b), 27.1093(b), and 29.1093(b).

Proposal 3-35. The proposal for § 25.1103(d), concerning turbine engine air duct systems, is related to a proposed amendment to § 25.1103 that is contained in Airworthiness Review Program Notice No. 8 (Notice 75-31). The proposed amendment to § 25.1103(d), contained in Notice No. 3, is therefore deferred until final rule-making action with respect to the related proposal in Notice 75-31. Comments submitted for Proposal 3-35 will be considered at that time.

Proposal 3-36. One commentator suggested that proposed § 25.1121(b) be revised by adding the words "probable" before "leakage" and "hazardous" before "fire". The FAA does not agree. The consequences of leakage from systems carrying flammable fluids can be sufficiently hazardous to warrant the assumption of leakage even if not probable. Also, the FAA regards any fire as being hazardous.

For the reasons given in the discussion relating to Proposal 3-12, proposed § 25.1121 (b) has been revised to make it clear that shields used for exhaust system parts are parts of the exhaust system.

Proposal 3-37. One commentator agreed with the proposed amendment to § 25.1123 but preferred to see all APU requirements separately stated rather than combined with the requirements for propulsion engines. The FAA, however, believes that identical requirements should be in the same section unless the applicability needs further clarification. Since no need was shown by the commentator, the proposal is adopted without substantive change.

Proposal 3-38 In response to an inquiry in the explanation of proposed new § 25.1129, several commentators stated that the proposal was covered by proposed § 25.901(c). The FAA agrees and the proposal is withdrawn.

Proposal 3-39. Several commentators stated that proposed § 25.1141(f) should apply only to valves that are essential to the safe operation of the airplane. The FAA disagrees. If any power-assisted valve is used, the flight crew might rely on it and should have an indication of when the valve is in the fully open or fully closed position, or when it is moving between the fully open and fully closed position.

The same commentators noted that an indication that the valve has attained the selected position should be required. For discussion of this comment and revision of new §§ 25.1141(f)(1) and (2), see Proposal 3-13.

Proposal 3-40. Several commentators objected to proposed §§ 25.1145(c), 27.1145(b), and 29.1145(c), concerning groups of ignition switches. The commentators stated that these new requirements were not necessary for turbine engines that do not require continuous ignition. The FAA agrees, since inadvertent movement of the ignition switch would not affect the operation of such an engine once that engine has been started. Accordingly, §§ 23.1145(c), 25.1145(c), 27.1145(b), and 29.1145(c) are revised to except the ignition switches for these engines from the requirement to have a means to prevent inadvertent operation of the group of ignition switches.

Proposal 3-41. The proposed § 25.1195(b), concerning fire extinguisher discharge, is related to a proposed amendment to § 25.1195(b) that is contained in Airworthiness Review Program Notice No. 8 (Notice 75-31). The proposed amendment to § 25.1195(b) contained in Notice No. 3, is therefore deferred until final rule-making action with respect to the related proposal in Notice 75-31. Comments submitted for Proposal 3-41 will be considered at that time.

Proposal 3-42. No unfavorable comments were received on the proposal to amend § 25.1197. Accordingly, the proposal is adopted without substantive change.

Proposal 3-43. A commentator recommended a revision of the first sentence of proposed § 25.1199(b) concerning the location of pressure relief discharges of fire extinguishing agents. The commentator suggested that the discharge end be required to be located to avoid hazard to the airplane rather than damage. The FAA disagrees. The proposal is intended to provide for the consideration of damage such as corrosion that may be caused by the discharge of fire extinguishing agents. The commentator's suggestion would not clearly provide for such necessary consideration.

Proposal 3-44. One commentator questioned proposed § 25.1207. The commentator stated that analysis should not be permitted as the sole method of showing compliance with the fire protection requirements. The FAA agrees that some of the requirements of §§ 25.1181 through 25.1203 may be complied with by analysis alone, while others require other methods of substantiation. Section 25.1207(d) is therefore revised to make clear that unless tests are specifically required in §§ 25.1181 through 25.1203 analysis is an acceptable method of showing compliance.

Another commentator pointed out that proposed § 25.1207(b) as written would preclude the use of the Statham test to determine extinguisher agent concentrations in an actual fire zone, contrary to his understanding that the Statham test method is acceptable. The FAA agrees and proposed paragraph (b) is revised to specify "tests of components," instead of "bench fire tests of components."

Proposal 3-45. For a discussion of the withdrawal of proposed § 25.1305(a)(9), see Proposal 3-29.

Proposals 3-46 and 2-86. Disposition of Proposal 2-86 (Notice 75-10) to amend § 25.1337(a) was deferred so that it could be considered in connection with Proposal 3-46, also to amend § 25.1337(a).

Two commentators concurred with Proposal 2-86, but believed that a review of other paragraphs of Part 25 affecting APU installations is required. The FAA does not agree. If other requirements are determined to be applicable to APU installations, additional proposals will be made in future rule-making actions. The FAA finds no reason to withhold adoption of these proposals pending such a determination.

No unfavorable comment was received on Proposal 3-46 and the proposal is adopted without substantive change.

Proposals 3-47 and 2-94. Disposition of Proposal 2-94 (Notice 75-10) to revise §§ 25.1549(a), (b), and (c) was deferred so that it could be considered in connection with Proposal 3-47, to amend § 25.1549(d).

One commentator concurred with Proposal 2-94, but pointed out that while it accommodated vertical scale instruments it did not accommodate horizontal scale instruments. The FAA agrees, and § 25.1549 as adopted will provide marking standards appropriate to circular, horizontal, and vertical scale powerplant instruments.

Another commentator believed that the proposal to provide specific requirements for marking vertical tape instruments, to provide for cockpit instrument standardization, is not appropriate for today's turbine engines. The commentator indicated the requirement could produce overlapping markings which could be misleading and, under certain operating conditions, could indicate that an unsafe condition is safe. The commentator recommended that markings for vertical tape engine instruments not be specified because such standardization is not in the best interest of safety. The FAA believes that overlap markings on tape instruments, similar to the overlap markings on round face instruments, will provide an adequate and safe presentation.

No unfavorable comment was received on Proposal 3-47, to amend § 25.1549(d) and the proposal is adopted without substantive change.

Proposal 3-48. Proposed § 25.1557(e) was intended to implement the requirement in Proposal 3-20 and is withdrawn because of the withdrawal of that proposal.

Proposal 3-49. No unfavorable comment was received on the proposal to amend § 25.1585. Accordingly, the proposal is adopted without substantive change.

Proposal 3-50. One commentator objected to the proposed amendments to §§ 27.571 (a) and 29.571(a). The commentator stated that the addition of the language "rotor drive systems between the engines and the rotor hubs" to the parenthetical description of flight structure is misleading and unnecessary. In support, the commentator suggested that the fatigue evaluation of the rotor drive system is accomplished upon compliance with §§ 27.923 or 29.923. The commentator's reply indicates (as was noted in the explanation for the proposals) the need for a clarification that the fatigue evaluation of §§ 27.571 and 29.571 includes portions of the rotor drive system. Sections 27.923 and 29.923 are primarily endurance test requirements, while §§ 27.571 and 29.571 are the fatigue evaluation requirements. It is therefore appropriate to include the rotor drive systems in the parenthetical description of the flight structure that must be included in the fatigue evaluation of §§ 27.571 or 29.571, as applicable.

Accordingly, the proposed amendments to §§ 27.571(a) and 29.571(a) are adopted without substantive change.

Proposal 3–51. One commentator objected to the proposed amendments to §§ 27.901 (c)(1) and 29.901(b)(1)(i) that, if adopted, would require compliance with the engine installation instructions provided under § 33.5(a). The commentator stated that the installation instructions are apparently aimed at field information for the owner and in any case § 33.5 does not require that this information be provided until just prior to engine certification in many cases. The commentator recommended that the requirement should not refer to § 33.5 but to specific engine installation parameters which are essential to proper engine performance and which are exclusively the responsibility of the engine manufacturer.

The installation instructions of § 33.5(a), in general, include a description of the location of mounting attachments and methods of attachment of the engine and engine components. The FAA believes this information is particularly pertinent to rotorcraft type certification. The FAA further believes that the installation instructions will be prepared by the engine type certificate applicant at the early stages of the engine type certification program. The commentator's suggestion that specific engine installation parameters be identified (rather than adopting the proposed reference to § 33.5) could lead to the failure to consider other installation parameters that may be significant to safety. Also see Proposal 3–21.

Proposal 3–52. Two commentators suggested that proposed § 27.923(e) may be subject to misinterpretation but indicated that this was not a problem to them. Proposed § 27.923(e) includes language similar to current § 29.923(b)(2). The FAA believes these requirements should be consistent and therefore believes the wording should be similar to avoid a different interpretation.

Two commentators objected to proposed § 27.923(j) concerning the 30-minute power test for certain multiengine rotorcraft. The commentators indicated that proposed § 27.923(j) is inconsistent with proposed § 27.923(b) since more than 100 hours of testing would be required. The FAA does not believe that the proposed paragraphs are inconsistent. Proposed paragraph (b) would require that the rotor drive system and controls on all rotorcraft be tested for not less than 100 hours, and proposed paragraphs (c) through (e) would merely establish the kinds of tests included in those 100 hours. Proposed paragraph (j), which would apply only to rotorcraft for which the use of 30-minute power is requested, would require testing in addition to the 100 hours.

Another commentator stated that the FAA should not "bother with the change from 'power' to 'torque' as it leads to very confusing wording". The change of language to "torque" and "speed" was proposed because the FAA believes these are the parameters generally used by applicants in conducting the rotor drive system tests. The additional reference in the proposal to power, e.g., the 2½ minute and 30-minute power runs specified in paragraphs (e) and (j), is made to establish the relationship between the torque and speed and the corresponding engine power rating.

A commentator considered the cyclic aspect of testing to be important and suggested that the proposal specify the number and duration of cycles rather than the overall time. The FAA disagrees. The proposal does not change the terms of current § 27.923(f) which provides flexibility in establishing testing intervals (cycles). The FAA is not aware of a problem that would justify changing these minimum test intervals.

The same commentator also believed the proposed test runs at 2½ minute and 30-minute power were inadequate and compared poorly with the test required to qualify the engine under Part 33. The FAA disagrees. As stated in the explanation, the 2½ minute and 30-minute power test in the proposal for a normal category rotorcraft is to demonstrate that the rotor drive system can absorb the torque of engines operating at 2½ minute and 30-minute power. These ratings, however, are not incorporated into the performance requirements as is the case under Part 29, for transport category rotorcraft, and no performance credit is realized from their use. Therefore, the FAA believes the test is adequate under Part 27.

Proposals 3-53 and 2-118. Proposal 2-118 was deferred so that it could be considered with Proposal 3-53 since both proposed to amend § 27.927(b)(2). Proposal 2-118 would change the words "one hour" in § 27.927(b)(2) to "fifteen minutes". In this connection a commentator asked if due consideration had been given to the 30-minute emergency power rating when establishing the time requirement. The 30-minute power is taken into account by the terms of the requirement for test at maximum torque attainable under probable operating conditions.

Two commentators to Proposal 3-53 believed that in proposed § 27.927(b)(2) the word "outputs" should be "inputs". The FAA agrees and the proposal is revised accordingly.

One commentator stated that the 15-minute duration specified in proposed § 27.927(c), concerning operation after loss of oil pressure, should be 5 minutes to bring it into line with the protection time specified in current § 27.861. The FAA does not agree. The 5-minute duration is specified in § 27.861 since the occurrence of a fire normally necessitates immediate descent and landing. Loss of oil pressure in the rotor drive system does not correspondingly necessitate immediate descent and landing. The 15-minute requirement would provide for a reasonable durability of the system following the loss of oil pressure.

Two commentators believed that in proposed § 27.927(c) the term "autorotative conditions" was vague and should be replaced with the term "the low power conditions of autorotative flight". The FAA does not agree. Under autorotative conditions no power is transmitted from the engine to the rotor blades. Therefore a low power condition of the engine would not be applicable.

A commentator believed that the use of the word "torgue" in place of "power" was confusing. The commentator indicated that the proposal could be interpreted to permit a static test since only torque and no rotational speed is specified. The proposal to use the word "torque" was made since the tests are run on the basis of the torque absorbed by the rotors. The torque being absorbed is that produced by the operating engine and transmitted through the rotor drive system.

A commentator stated that proposed paragraph (c) did not consider the design alternative of a back-up oil system. The FAA agrees that compliance by the use of a second oil system after failure of the primary system should be allowed. Proposed §§ 27.927(c) and 29.927(c) are revised accordingly.

A commentator suggested that it should be noted that the drive system need not be in condition for continued operation after the 15-minute test prescribed in paragraph (c). The FAA agrees that compliance with the proposal would be achieved after the 15-minute test was successfully run regardless of the condition of the rotor drive system.

Proposal 3-54. No unfavorable comments were received on the proposal to amend § 27.965. Accordingly, the proposal is adopted without substantive change.

Proposal 3-55. Several commentators to the proposed amendment of §§ 27.1093(b) and 29.1093(b) apparently failed to note the changes made by Amendment Nos. 27-9 and 29-10 (39 FR 35452; October 1, 1974). The proposals intended only to add the language "and its air inlet system" to §§ 27.1093(b)(1) and 29.1093(b)(1) and to restructure both sections to incorporate the added language. For a discussion of a change made to proposed § 27.1093(b), see Proposal 3-34.

Proposal 3-56. One commentator stated that § 27.1121(d), unlike §§ 23.1121(b) and 29.1121(b), did not need the clarification proposed. The FAA agrees that § 27.1121(d) did not use the language "dangerously close" that had been an administrative problem in §§ 23.1121(b) and 29.1121(b). However, beside the desire for consistency among the airworthiness certification parts, the FAA believes that proposed § 27.1121(d) provides a more comprehensive standard and will allow greater design flexibility.

For a discussion of changes made to proposed § 27.1121(d), see Proposal 3-12. No unfavorable comments were received concerning proposed § 27.1121(g) and it is adopted without substantive change.

Proposal 3-57. A commentator objected to proposed § 27.1141(d). The commentater stated that this proposal was not deemed necessary for Part 29 and asked why it was necessary for Part 27. The FAA disagrees that a similar requirement was not deemed necessary for Part 29. Proposed § 29.901(c) that is adopted in this amendment will require a similar consideration for powerplant controls in transport category rotorcraft. Further, the FAA believes that this requirement is necessary for normal category rotorcraft. Many turbine powerplant control systems on normal category rotorcraft are inherently complex. Considering such complexity, the FAA believes that consideration must be given to system redundancy, alternate devices, and duplication of functions in the design of certain turbine powerplant control systems.

Another commentator stated that the proposal to add a new § 27.1141(c) would require position indicators for all powerplant controls and considered this to be an excessive and unnecessary requirement. The FAA disagrees. The proposed new § 27.1141 (c) applies only to powerplant valve controls located in the cockpit. For discussion of the revision of new §§ 27.1141(c)(1) and (2), see Proposal 3-13.

Proposal 3-58. One commentator stated that the proposed changes to §§ 27.1145(b) and 29.1145(c), concerning the prevention of inadvertent operation of each group of ignition switches, would seem to contradict current §§ 27.1145(a) and 29.1145(b). Sections 27.1145(a) and 29.1145(b) require a means to quickly shut off all ignition by the grouping of switches or by a master ignition control. The FAA believes that the means provided to prevent inadvertent operation can be designed so that it will not prevent or adversely affect the ability to quickly shut off all ignition.

See Proposal 3-40 for a discussion of the revision of proposed § 27.1145(b) to provide an exception for turbine engines that do not require continuous ignition.

Proposal 3-59. A commentator stated that the revisions proposed for §§ 27.1305(e) and 29.1305(a)(5), concerning altitude engines, are not needed since the current rules are clear. The FAA believes that, considering the proposed new definition for an "altitude engine" that is adopted as an amendment to § 1.1 in this document, the proposed revisions concerning altitude engines in the airworthiness rules are not needed. The term "altitude engine" that is used in §§ 23.1305(h), 27.1305(e), and 29.1305(a)(5) will include a derated engine as well as a supercharged engine after the amendment to § 1.1. Accordingly, proposed §§ 23.1305(h), 27.1305(e), 29.1305(a)(5) are withdrawn.

Proposal 3-60. No unfavorable comments were received on the proposal to amend § 27.1337(a). Accordingly, the proposal is adopted without substantive change. Also see Proposal 3-18.

Proposal 3-61. For a discussion of a comment concerning § 29.571(a), see Proposal 3-50.

Proposal 3-62. A commentator stated that proposed §§ 29.901(b)(1)(iii) and (c) are redundant and unnecessary. The FAA agrees that proposed § 29.901(b)(1)(iii) is unnecessary, and it is withdrawn. The FAA does not agree that proposed § 29.901(c) is redundant and unnecessary. Experience has shown the need for a failure requirement that is explicitly applicable to powerplant and auxiliary power unit installations.

One commentator stated that considering probable combinations of failures in proposed § 29.901(c) is inconsistent with the overall philosophy of Part 29. However, since the commentator did not state its view of the overall philosophy of Part 29, the FAA cannot respond to this comment.

The commentator suggested that engine rotor disc failures should be excluded from the consideration required by paragraph (c) since the rotorcraft environment is much more complex than in the case of an airplane. Also the commentator asserted that a lower incidence of fatigue failure can be expected in rotorcraft engines than in airplane engines. The FAA agrees and § 29.901(c) is revised to exclude engine rotor disc failures from consideration under that paragraph.

For comments related to the proposed amendment of § 29.901(b)(1)(i), see Proposal 3-51.

Proposal 3-63. No unfavorable comment was received on the proposed deletion of paragraphs (d) and (e) in § 29.903, and the paragraphs are deleted. Also, see Proposal 3-64.

Proposal 3-64. A commentator, while generally agreeing with proposed new § 29.908, objected to its applicability to the entire cooling fan. The commentator stated that there is no service or test history that indicates a need to consider the entire fan. The

FAA believes that the absence of cooling fan failures is due to the requirements of current § 29.1461 which applies to cooling fans that incorporate high energy rotors. In view of the requirements of current § 29.1461 and the fact that there is no service experience of fan failures, the FAA considers that proposed § 29.908 should be revised to be applicable only to cooling fan blade failures. Proposed § 29.908 is revised accordingly.

A commentator stated that loss of cooling may affect the continued safe operation of one or more engines and so prevent continued safe flight. The FAA did not intend to consider the effect of cooling loss but is concerned only with the fragmentation effect of a fan blade failure.

Proposal 3–65. A commentator believed the specification of 15 minutes in proposed § 29.927(c), concerning the loss of rotor drive system oil pressure, was inadequate for category A helicopters which have engine-out capability. Therefore, the commentator indicated, operations are planned over routes where a landing may not be possible within 15 minutes. The intent of the proposal is to enable the pilot to make an autorotative landing after loss of rotor drive system oil pressure and the FAA believes that the proposed 15 minute requirement is adequate for that purpose.

For a discussion of other comments related to proposed § 29.927(c), see the discussion of Proposal 3–53.

Proposal 3–66. A commentator stated that under his interpretation of § 29.965 only a pressure test is required for non-metallic fuel tanks, and he also recommended that slosh testing of non-metallic tanks be added as a requirement. The FAA disagrees. Paragraphs (a), (b), and (c) of § 29.965 apply prescribed pressure tests to all fuel tanks. In addition, § 29.965(d) already applies the slosh test requirement to each tank with large unsupported or unstiffened flat areas, or with other features whose failure or deformation could cause leakage. The proposal is adopted without substanve change.

Proposal 3–67. No unfavorable comments were received on the proposal to amend § 29.991(b). Accordingly, the proposal is adopted without substantive change.

Proposal 3–68. No unfavorable comments were received on the proposal to amend § 29.995. Accordingly, the proposal is adopted without substantive change.

Proposal 3–69. Although there were no unfavorable comments to the proposed amendment of § 29.1093(b) concerning the addition of the inlet system to the consideration required in paragraph (b)(1), the proposal is revised based on a comment to Proposal 3–34. See the discussion for Proposal 3–34.

Proposal 3–70. For a discussion of the revision to § 29.1121(b), see Proposal 3–12.

Proposal 3–71. Although there were no unfavorable comments to proposed § 29.1141 (f), the proposal is revised based on a comment to Proposal 3–13. See the discussion for Proposals 3–13 and 3–57.

Proposal 3–72. For a discussion of proposed § 29.1145(c), see Proposals 3–40 and 3–58.

Proposal 3–73. Two commentators objected to the proposal to amend § 29.1193(e) on the grounds that present fire protection requirements for category B rotorcraft are adequate and that the proposal would place an undue weight and cost burden on category B rotorcraft. The FAA disagrees. Service experience has shown that the fire protection requirements specified in § 29.1193(e) should apply to all category of rotorcraft, especially those that may not be required to have fire extinguishing and fire detection systems. The FAA believes that the increase in cost and weight associated with this requirement is justified by the increment of safety attained. The proposal is therefore adopted without substantive change.

Proposal 3–74. No unfavorable comment was received on the proposal to amend § 29.1195. Accordingly, the proposal is adopted without substantive change.

Proposal 3–75. No unfavorable comments were received on the proposal to amend § 29.1197. Accordingly, the proposal is adopted without substantive change.

Proposal 3–76. No unfavorable comment was received on the proposal to amend § 29.1199, and the proposal is adopted without substantive change. Also, see discussion for Proposal 3–43.

Proposal 3–77. For a discussion of the withdrawal of proposed § 29.1305(a)(5), see Proposal 3–59.

Proposals 3-78 and 2-185. Disposition of Proposal 2-185 (Notice 75-10) to amend § 29.1337(a) was deferred so that it could be considered in connection with Proposal 3-78, which is also a proposal to amend § 29.1337(a). No unfavorable comment was received on either proposal. Accordingly, the proposals are adopted without substantive change.

Proposal 3-79. No unfavorable comments were received on the proposal to amend § 33.15. Accordingly, the proposal is adopted without substantive change.

Proposal 3-80. No unfavorable comments were received on the proposal to amend § 33.17. Accordingly, the proposal is adopted without substantive change.

Proposal 3-81. No unfavorable comments were received on the proposal to amend § 35.17. Accordingly, the proposal is adopted without substantive change.

Proposal 3-82. No unfavorable comments were received on the proposal to amend § 35.35. Accordingly, the proposal is adopted without substantive change.

These amendments are made under the authority of sections 313(a), 601, and 603 of the Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421, and 1423), and of section 6(c) of the Department of Transportation Act (49 U.S.C. 1655(c)).

In consideration of the foregoing, and for the reasons stated in Notices 75-10 and 75-19, Parts 1, 23, 25, 27, 29, 33, and 35 of the Federal Aviation Regulations are amended as follows, effective May 2, 1977.

The Federal Aviation Administration has determined that this document does not contain a major proposal requiring preparation of an Inflation Impact Statement under Executive Order 11821 and OMB Circular A-107.

Amendment 27–13

Airworthiness Review Program
Amendment No. 5: Equipment and Systems Amendments

Adopted: July 11, 1977 **Effective: September 1, 1977**

(Published in 42 FR 36960, July 18, 1977)

SUMMARY: The purpose of these amendments is to update and improve the airworthiness standards applicable to aircraft equipment and systems and to make related changes in the operating rules. These amendments are part of the Airworthiness Review Program.

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SUPPLEMENTARY INFORMATION: These amendments are the fifth in a series of amendments to be issued as part of the Airworthiness Review Program. The following series of amendments have previously been issued as part of this Airworthiness Review Program:

Title	*FR citation*
Form number and clarifying revisions	(40 FR 2576; January 14, 1975)
Rotorcraft anticollision lights standards	(41 FR 5290; February 5, 1976)
Miscellaneous amendments	(41 FR 55454; December 20, 1976)
Powerplant amendments	(42 FR 15034; March 17, 1977)

These amendments are based on two Notices of Proposed Rule Making—Notice 75–10 published in the Federal Register on March 7, 1975 (40 FR 10802); and Notice 75–23 published in the Federal Register on May 27, 1975 (40 FR 23048). The amendments based on Notice 75–10 were deferred in the series of amendments titled "Miscellaneous Amendments" so that they could be considered in conjunction with the final disposition of certain proposals in Notice 75–23. The discussions of the comments received for the deferred proposals are included under the heading of the related Notice 75–23 proposals.

Interested persons have been afforded an opportunity to participate in the making of these amendments and due consideration has been given to all matter presented. A number of substantive changes and changes of an editorial and clarifying nature have been made to the proposed rules based upon relevant comments received and upon further review within the FAA. Except for minor editorial and clarifying changes and the substantive changes discussed below, these amendments and the reasons for their adoption are the same as those contained in Notices 75–10 and 75–23.

Two of the proposals of the original Notice concerning rotorcraft anticollision lights (§§ 27.1401 and 29.1401) have been implemented by separate rule-making action, Amendments 27–10 and 29–11, effective February 5, 1976, that were published in the Federal Register on February 5, 1976 (41 FR 5290). In addition, several proposals which were contained in Notice 75–23 are not being dealt with here but will be considered in conjunction with the proposals contained in Airworthiness Review Program, Notice No. 7: Airframe Proposals (Notice 75–26; 40 FR 24802; June 10, 1975).

DISCUSSION OF COMMENTS

The following discussion is keyed to the like-numbered proposals contained in Notice 75–23.

Proposal 5–1. One commentator objected to the marking (or tagging) requirement in proposed § 23.1301(a)(2), which would require that the marking or tag include identification, function, and operating limitations, on the ground that it would necessitate a multitude of tags on small items of equipment which could interfere with operation of the aircraft or otherwise constitute a hazard. Another commentator contended that the service record does not justify a need for the requirement. Another commentator recommended that this requirement be expanded to require that the marking or tag include information to show that the equipment had been produced under an approved FAA quality control system, or that it had been approved by the FAA for installation on a particular type of aircraft. After further review, the FAA agrees with the first commentator and believes that the proposed marking or tagging requirement should be withdrawn. Accordingly, the requirement in proposed § 23.1301(a)(2) is withdrawn. However, current § 23.1301(a)(2) is amended by deleting the words "if appropriate" for consistency with §§ 25.1301, 27.1301, and 29.1301.

One commentator objected to the requirement in proposed § 23.1301(b) on the ground that it would be extremely difficult, or impossible, in the design of an item of equipment, or of its installation, to provide absolute assurance that it is incapable of interfering with the operation of interfacing equipment under all possible failure conditions. Another commentator stated that the wording of the proposal could be interpreted to mean that fully redundant equipment systems must be installed. The FAA agrees that proposed § 23.1301 (b) would be unnecessarily restrictive, and it is withdrawn. In view of the withdrawal of proposed § 23.1301(b), the paragraphs in § 23.1301, as adopted, have been redesignated.

The proposed revision of the lead-in of current § 23.1301(a) was intended to expand the applicability of that paragraph to cover all optional equipment, consistent with corresponding language in current §§ 25.1301, 27.1301, and 29.1301. One commentator objected because it would require markings on additional items of optional equipment. The FAA believes that the marking of all equipment items contributes significantly to safety by helping to prevent their improper installation and operation, and the lead-in of § 23.1301(a) is revised as proposed.

Proposals 5-21, 5-39, and 5-53 to revise §§ 25.1301(b), 27.1301, and 29.1301, respectively, are withdrawn for the reasons stated herein with respect to proposed § 23.1301.

Proposal 5-2. The deletion of current § 23.1309(a) was proposed because it would have been superfluous if proposed § 23.1301(b) (see Proposal 5-1) had been adopted. Proposed § 23.1301(b) is withdrawn. Consequently, the proposed deletion of current § 23.1309(a) is also withdrawn.

Proposal 5-3. Several commentators questioned proposed §§ 23.1321(a), 25.1321(a), 27,1321(a) and 29.1321(a) (Proposals 5-3, 5-23, 5-42, and 5-56, respectively) concerning the visibility of instruments with a visual indicator for use in flight by any pilot. It was stated that the proposed standard did not adequately provide for instruments that were monitored infrequently during flight as contrasted with instruments more critical to flight safety. With respect to rotorcraft, one commentator also objected on the ground that the space available for mounting instruments was extremely limited. The FAA agrees that priority of instruments and instrument location needs to be more definitive. Therefore, proposed §§ 23.1321(a), 25.1321(a), 27.1321(a) and 29.1321(a) are withdrawn.

Several commentators objected to the phrase "under all cockpit lighting conditions" in proposed §§ 23.1321(e), 25.1321(e) 27.1321(d), and 29.1321(g), contending that it includes everything from lightning to total darkness resulting from complete electrical failure at night. In light of these comments and after further FAA review, proposed §§ 23.1321(e), 25.1321(e), 27.1321(d), and 29.1321(g) are revised to require consideration of all probable cockpit lighting conditions with respect to the visibility of malfunction indicators.

For another comment related to proposed § 23.1321(e), see Proposal 5-23.

Proposal 5-4. One commentator objected to proposed § 23.1323 on the ground that the resulting economic burden to aircraft owners is unwarranted. Another commentator objected to proposed § 27.1323(a) contending that it was unnecessary to calibrate the airspeed indicating instrument. The FAA disagrees with these comments. A requirement for the calibration of the airspeed indicating instrument is necessary to ensure that excessive error is not introduced into the system by the installation of a replacement instrument after the aircraft goes into service. In addition, the FAA believes that although the proposed calibration standards differ from the current standards, they impose little, if any additional burden in showing compliance.

Another commentator (who concurred with the intent of the proposal to revise § 25.1323) questioned whether the allowable error, in proposed § 23.1323(b), should be expressed in terms of calibrated airspace rather than indicated airspeed and whether the airspeed ranges specified in proposed §§ 23.1323(b)(1) and (b)(2) were unnecessarily severe accuracy requirements. The FAA agrees that the error allowed by proposed § 23.1323(b) should be expressed in terms of calibrated airspeed to be in accord with normal practices. However, the FAA believes that the airspeed ranges in proposed §§ 23.1323(b)(1) and (b)(2) are needed to encompass the airspeed limitations in proposed § 23.1545. The FAA also believes that, as a practical matter, the accuracy requirements in proposed § 23.1323 are not significantly more restrictive than the current requirements.

Accordingly, § 23.1323 is revised as proposed, except that the term "indicated airspeed" in paragraph (b) is changed to "calibrated airspeed."

Proposal 5-5. One commentator objected to the proposal to add a new § 23.1325(d), which would be identical to the standard required by § 25.1325(e), on the ground that general aviation airplanes should not be required to conform to transport category airplane standards. A key function of the altimeter system is to enable the pilot to maintain his assigned or required altitude during flight for the purpose of maintaining vertical separation from other aircraft. There is therefore a need for altimeter system accuracy for all aircraft.

Another commentator stated that the proposal would place accuracy requirements on static pressure systems that are more stringent than the requirements proposed for airspeed indicating system in Proposal 5-4. The commentator stated that, under Proposal 5-4, a 5-knot error at 100 knots would be acceptable and this corresponds to an altitude of more than 30 feet which would not be acceptable under proposed § 23.1325(d). The commentator suggested that the proposed altitude error tolerance of ±30 feet (per 100 knots speed) be increased to ±50 feet. The FAA disagrees with the commentator's suggestion. The proposed standard is identical to the standard required for transport category airplanes, which has been administered without difficulty in the past.

Proposal 5-6. One commentator objected to the proposal to amend § 23.1327 on the ground that it would allow an indefinite amount of interference, which would confuse the pilot. The FAA believes that the placard that would be required by proposed § 23.1327(c) would serve to alert the pilot to the fact that certain electrical loads, when switched on, cause excessive deviations of the magnetic nonstabilized direction indicator. The commentator further stated that if an additional magnetic direction indicator (having a deviation less than 10 degrees) is installed, there would no longer be a need for the magnetic nonstabilized direction indicator. The FAA agrees that an additional magnetic nonstabilized direction indicator is not a practical alternative, and proposed § 23.1327 is revised to delete that alternative. However, the FAA believes that the proposed exception is appropriate for those instances in which a magnetic stabilized direction indicator or gyroscopic direction indicator is installed along with a magnetic nonstabilized direction indicator. The commentator also contended that the gyroscopic direction indicator alternative is not a practical solution because it must be reset frequently, thus increasing the pilot's workload. The FAA does not believe that the need to periodically reset the gyroscopic direction indicator adds significantly to the pilot's workload. Finally, this commentator stated that proposed § 23.1327(c) would allow interference that is contrary to current §§ 23.1327(a) and 23.1301(a)(4). With respect to current § 23.1327(a), the FAA believes the comment is valid, and that paragraph is revised for clarification. In view of this change, the requirements in current § 23.1327(a) and proposed § 23.1327(b) are combined into § 23.1327(a), and proposed § 23.1327(c) is redesignated § 23.1327(b). With respect to current § 23.1301(a)(4), the FAA does not believe the comment is valid, since the system consisting of a magnetic nonstabilized direction indicator and either a magnetic stabilized type or a gyroscopic type would meet that requirement.

Another commentator suggested that short term deviations (up to 30 seconds), caused by switching transients should be allowed without placarding the installation. The FAA does not agree. In general, the duration of switching transients is so short that their effect on the magnetic nonstabilized direction indicator is negligible. However, if switching does result in deviations exceeding 10 degrees for substantial intervals, the FAA believes the pilot must be so informed (by placarding) to avoid being misled or confused.

Proposal 5-7. The proposal to amend § 23.1329 is similar to proposals to amend §§ 25.1329 and 29.1329 and to the proposal to add a new § 27.1311 (Proposals 5-24, 5-58, and 5-41, respectively). Other related proposals affecting §§ 25.1329, 27.1329, and 29.1329 were set forth in Airworthiness Review Notice No. 2 (Notice 75-10) as Proposals 2-84, 2-129, and 2-184, respectively, and their disposition was deferred for consideration with Proposals 5-24, 5-41, and 5-58 respectively. The FAA is still reviewing all of these proposals, which concern automatic pilot systems. To avoid delaying the adoption of the amendments contained in Airworthiness Review Program Amendment No. 5, the disposition of these proposals has been deferred until final rule-making action is taken with respect to the proposals contained in Airworthiness Review Program, Notice No. 7; Airframe Proposals (Notice 75-26; 40 FR 24802; June 10, 1975).

Proposals 5-8 and 2-37. For comments related to the proposal to revise § 23.1335, and for an explanation of the revisions to proposed § 23.1335, see Proposal 5-27.

Disposition of Proposal 2-37 to delete § 23.1335 (Notice 75-10 was deferred so that it could be considered in connection with Proposal 5-8. Proposal 2-37 is being withdrawn in view of the adoption, with revisions, of Proposal 5-8.

Proposal 5-9. One commentator suggested that the phrase "not used solely for starting engines" in proposed § 23.1351(f) could be misinterpreted. The explanation in the notice stated that the proposal was intended to prevent damage to the aircraft's electrical system if reverse polarity or reverse phase sequence of the external power source occurred. Therefore, as suggested by the commentator, proposed §§ 23.1351(f), 25.1351(c), 27.1351(e), and 29.1351(d) (designated as § 29.1351(c)) are clarified to require protection if "external power can be electrically connected to equipment other than that used for engine starting."

One commentator objected to proposed §§ 27.1351(e) and 29.1351(d) on the ground that they do not provide a reasonable limit on the extent to which one has to go to ensure that a reverse polarity connection cannot be made. The FAA believes that the proposals are clear and unambiguous as to their intent and as to what is required. The FAA believes that a more detailed requirement would be unnecessarily restrictive.

One commentator objected to proposed § 25.1351(c) on the ground that it does not cover every external power condition that should be protected against, and that its objective is already covered by current regulations on electrical systems and equipment. The purpose of the proposal for protection against those hazardous conditions involving external power that have occurred in service. With respect to the current regulations on electrical systems and equipment, they are not sufficiently specific to adequately deal with the subject matter of these proposals.

Proposal 5-10. No favorable comments were received on the proposed revisions of §§ 23.1353(b)(1), 25.1353(c)(1)(i), 27.1353(b)(1) and 29.1353(c)(1)(i) and those sections are amended as proposed.

Several commentators recommended that proposed §§ 23.1353(g), 25.1353(c)(6), 27.1353(g) and 29.1353(c)(6), be revised to apply to lead-acid batteries in addition to nickel cadmium batteries and to apply to batteries not used for starting as well as those used for starting. The FAA does not agree. There is no history of hazardous effects on structure or essential systems caused by excessive heating of lead-acid batteries. With respect to nickel cadmium batteries, excessive heating has only been associated those batteries that were being used for starting.

One commentator stated that the content of proposed § 23.1353(g) is already covered by the first sentence of § 23.1353(b), which states that "safe cell temperatures and pressures must be maintained during any probable charging and discharging condition". The FAA does not agree. That requirement covers the normal range of battery operating conditions and does not provide for the thermal runaway condition that has occurred in service with nickel cadmium batteries.

Another commentator contended that the temperature generated by a short circuit cannot be foreseen accurately and that it would be more advisable to take measures to prevent such short circuits instead of trying to counter their effects. The FAA believes that the temperature (and heat) generated by a short circuit can be determined with sufficient accuracy for design purposes. In addition, the FAA knows of no practical means that would prevent the internal short circuits of the battery that are caused by thermal runaway.

One commentator objected to proposed § 27.1353(g) because he considered that the proposal could be construed to require protection against damage that would not be hazardous. The FAA does not believe that the proposed language has that connotation. The intent of the term "hazardous effect" is to exclude non-hazardous damage that may occur.

One commentator suggested that warning systems, when provided, that alert the crew to take corrective action should be considered in determining the degree of thermal protection required for the surrounding structure. The FAA does not agree. Thermal protection is needed in case the warning is not observed by the crew, or the warning system itself fails.

Proposed §§ 23.1353(g), 25.1353(c)(6), 27.1353(g) and 29.1353(c)(6) are adopted without substantive change; however, they are designated as §§ 23.1353(f), 25.1353(c)(5), 27.1353(f), and 29.1353(c)(5), respectively.

Proposal 5-11. No unfavorable comments were received on the proposal to revise § 23.1357(b). Accordingly, the proposal is adopted without substantive change.

Proposal 5-12. No unfavorable comments were received on the proposal to amend § 23.1361(b). Accordingly, the proposal is adopted without substantive change.

Proposal 5-13. Several commentators objected to the increase in the anticollision light field of coverage requirement in the proposal to amend § 23.1401 on the ground that a light meeting the proposed requirement would be more expensive. One commentator contended that two anticollision lights would probably be needed to meet the proposed requirement, whereas only one was necessary to meet the current requirement in many instances. The FAA believes that the increased field of coverage can be attained with presently available anticollision lights by simply replacing the lens with another which redistributes the light output. The cost of the modified anticollision light would be about the same as that of those now in use. With regard to the need for two lights, the FAA believes that a single anticollision light that can be located on an airplane to meet a ±30 degrees coverage requirement without exceeding obstructed-visibility limits will in most instances meet the ±75 degrees coverage requirement without exceeding those limits.

One commentator objected on the ground that increasing anticollision light coverage does not improve safety in the air rescue situation, since normal crash landing techniques call for disabling all electrical power and the hazards associated with reapplying power to the anticollision lights outweight the benefits. The FAA disagrees. The restoration, or continuation, of electrical power is not hazardous in all situations. The commentator further stated that position lights make the airplane visible to the control tower from directly below, and that, with the increased coverage requirements, the obstructed-visibility limits should be increased proportionately. The FAA believes that the intensity of position lights in the 30 to 75 degree range is small compared to the proposed anticollision light standards, and would be ineffective. With regard to the obstructed-visibility limits, the FAA believes that the present limits can still be met with anticollision lights having the increased field of coverage. The commentator also contended that it is likely the proposed increase in anticollision lights field of coverage could preclude compliance with the requirement that the crew's vision be unimpaired. While the FAA believes that an increase in field of coverage requirements for rotorcraft anticollision lights even at reduced intensity levels would adversely affect crew vision because of objectionable multiple reflections in the cockpit from the rotor blades, the FAA does not believes that redistribution of the light emitted by anticollision lights on airplanes to cover ±75 degrees instead ±of 30 degrees would adversely affect the crew's vision.

In response to the proposal to amend § 25.1401, two commentators suggested that any proposal concerning anticollision lights should be discussed with the International Civil Aviation Organization (ICAO). However, the proposals as adopted will provide the same color requirement as the international standard. With regard to field of coverage, which is not an international standard but is set forth in an ICAO acceptable means of compliance, the adopted field of coverage requirement would meet that acceptable means of compliance. The FAA plans to propose a similar change in the ICAO field of coverage acceptable means of compliance.

Accordingly, the proposals to amend §§ 23.1401 and 25.1401 are adopted without substantive change.

Proposal 5-14. For comments related to the proposal to add a new § 23.1438, and for an explanation of revisions made to proposed § 23.1438, see Proposal 5-33.

Proposal 5-15. For comments related to the proposal to add new §§ 23.1447(c) and (d), and for an explanation of the revisions made to proposed §§ 23.1447(c) and (d), see Proposal 5-34.

Proposal 5-16. For comments related to the proposal to add a new § 23.1450, and for an explanation of the revisions made to proposed § 23.1450, see Proposal 5-35.

Proposal 5-17. One commentator suggested that proposed § 23.1461(b)(2) be expanded to require demonstration of satisfactory overspeed and overtemperature margins, establishment of safe fatigue lives, and a fault analysis to show freedom from defects such as burst due to shaft failure and failure due to undetected loss of cooling air. The FAA believes that proposed § 23.1461(b) adequately deals with overspeed and overtemperature conditions and the term "malfunctions" in proposed § 23.1461(b) includes the "defects" mentioned by the commentator. With regard to establishing safe fatigue lives, the FAA does not believe that the need for such a requirement has been demonstrated. For other comments related to this proposal, see Proposal 5-38.

The proposal to add a new § 23.1461 is adopted without substantive change.

Proposal 5-18. The FAA is currently still reviewing the proposals to amend §§ 23.1545, 27.1545, and 29.1545, concerning marking requirements for airspeed indicators. To avoid delaying the adoption of the amendments contained in Airworthiness Review Program Amendment No. 5, the disposition of these proposals has been deferred until final rule-making action is taken with respect to the proposals contained in Airworthiness Review Program, Notice No. 7: Airframe Proposals (Notice 75-26; 40 FR 24802; June 10, 1975).

Proposal 5-19. A commentator recommended that proposed § 23.1547(e) be revised by inserting the words "the operation of" before the words "electrical equipment" to be consistent with the language in Proposal 5-6. The FAA agrees, and proposed § 23.1547(e) is revised accordingly. The commentator further suggested that the placard be required to state "which conditions, or combination of conditions" rather than "which electrical loads, or combination of loads" because deviation is not solely related to electrical loads, and to state the maximum deviation that occurs for those conditions (or combination of conditions) which cause a deviation of more than 10 degrees, so that the pilot is informed of the maximum expected error. The FAA believes that the proposed language covers the sources of excessive deviation that are allowed. With regard to the maximum deviation, the FAA believes that in view of the placarding requirements proposed, a requirement concerning maximum deviation is unnecessary.

Proposals 5-20 and 2-63. Several commentators objected to the provision in proposed § 25.831(e) (Proposal 5-20) that would require a means for independent control of both temperature and quantity of ventilating air in each compartment or area occupied by crewmembers.

In light of the comments received, and after further review, the FAA believes that with respect to crewmember compartments or areas which are ventilated by air interchange with other compartments or areas, a requirement to provide independent control of ventilating air temperature and quantity would impose a burden of complexity and cost not commensurate with its probable contribution to safety. However, with respect to those crewmember compartments and areas which are not ventilated by air interchange with other compartments or areas under all operating conditions, the FAA believes that a means for independent control of ventilating air temperature and quantity must be provided for the occupants to ensure that their ability to perform safety-related functions is not impaired. Proposed § 25.831(e) is revised accordingly.

One commentator recommended that the 800 cubic feet specified in proposed § 25.831(f)(1), and the 5 degrees F. specified in proposed § 25.831(f)(2), be revised to 1100 cubic feet and 10 degrees F., respectively. This commentator contended that a 1100 cubic-foot limit would not affect safety adversely, and that a 10 degree F. temperature differential between flight crew and passenger compartments would not contribute significantly to crew or passenger discomfort. The FAA does not have sufficient information at the present time to justify relaxing the current requirement to the extent recommended by the commentator.

One commentator suggested that the temperature and ventilation controls referred to in proposed § 25.831(f)(3) should be accessible to both pilots. The FAA agrees, and proposed § 25.831(f)(3) is revised to require that the temperature and ventilation controls be accessible to the flight crew.

Disposition of Proposal 2-63 to amend § 25.831 (Notice 75-10) was deferred so that it could be considered in connection with Proposal 5-20. Proposal 2-63 is withdrawn in view of the adoption, with revisions, of Proposal 5-20.

Proposal 5-21. For comments related to proposed § 25.1301(b) and for the withdrawal of proposed § 25.1301(b), see Proposal 5-1.

Proposal 5-22. The proposed changes to §§ 25.1309(a) and (e) with respect to inserting the word "chapter" in place of "subchapter" were also proposed for § 27.1309(a) and §§ 29.1309(a) and (d) (Proposals 5-40 and 5-55, respectively).

Several commentators objected to the proposed change from "subchapter" to "chapter" because it would broaden the scope of the requirement to include equipment, systems, and installations required by the subchapters dealing with various operating rules. One commentator contended that the proposal would require that equipment prescribed in an operating subchapter be designed and installed in each aircraft in order to obtain a type certificate. In the light of these comments, and after further review, the FAA believes that the proposed change of the word "subchapter" to "chapter" in §§ 25.1309(a) and (e), 27.1309(a) and 29.1309(a) and (d) would impose an unreasonable burden on the aircraft manufacturer. Accordingly, this proposed change has not been made.

Two commentators objected to proposed § 25.1309(b)(1) on the ground that the added provision dealing with the loss of all propulsive power is already adequately covered in present § 25.671(d), and that the occurrence of any failure condition which would preclude controlled flight to an emergency landing after loss of all propulsive power would have to be "extremely improbable" and this cannot be achieved. The FAA agees, and proposed § 25.1309(b)(1) is withdrawn.

One commentator objected to proposed § 25.1309(b)(2) on the ground that "operational or performance capability", without qualification, is not a matter for safety regulation. In the light of this comment, and after further consideration, the FAA believes that the phrase "operational or performance capability of the airplane" could be misinterpreted and could cause difficulties in administering the requirement. Therefore, the FAA believes that the language in the current rule should not be changed in this regard. In addition, other commentators noted that the phrase "or the ability of the crew to cope with adverse operating conditions" in current § 25.1309(b)(2) had been omitted from proposed § 25.1309(b)(2) without explanation, and recommended that it be restorted as necessary for safety. The FAA agrees. The phrase was inadvertently omitted from the proposal. Accordingly § 25.1309(b)(2) as adopted retains the language in current § 25.1309(b)(2), except that the phrase "result in injury to the occupants, or" is deleted.

One commentator objected to proposed § 25.1309(d) contending that the method of compliance set forth in paragraph (d), which is applicable to paragraph (b), mandates unreasonably burdensome procedures. The requirements objected to by the commentator are contained in current § 25.1309. The FAA does not believe that requiring compliance with those provisions is unreasonably burdensome. Analyses along the lines prescribed in proposed § 25.1309(d) are being conducted by some manufacturers on a voluntary basis.

One commentator recommended that the term "flight simulator" in proposed § 25.1309(d) be changed to "simulator" to allow the use of simulators other than flight simulators. The FAA agrees, and proposed § 25.1309(d) is revised accordingly.

One commentator objected to proposed §§ 25.1309(e) and (d) because they are less stringent than the present requirements, which call for an analysis, and tests where necessary, showing that systems, controls, and associated monitoring and warning means are designed "so that crew errors that would create additional hazards are improbable". As pointed out in the explanation for Proposal 5-22, the FAA has concluded that requiring a showing of compliance with present § 25.1309(d) is unreasonably burdensome. In particular, the FAA believes that it is not practicable to quantify the probability of crew errors. The FAA believes that the requirement, "* * * to minimize crew errors which would create additional hazards", in proposed § 25.1309(c) would provide an adequate level of safety. Accordingly, proposed § 25.1309(c) is adopted without substantive change and the lead-in of § 25.1309(d) is amended to delete the reference to paragraph (c).

The proposed changes to §§ 25.1309(e) and (f) with respect to the two-engine-inoperative condition on aircraft with three engines are substantively identical to the proposed changes to §§ 29.1309(d) and (e) (Proposal 5-55). One commentator objected to proposed §§ 25.1309(e)(3) and (f), and proposed §§ 29.1309(d)(3) and (e), on the ground that they do not provide adequate guideance as to which loads are required during the proposed two-engine-inoperative condition on aircraft with three engines. This commentator recommended that the term "flight safety loads" be used instead of "essential loads" for that condition. The FAA does not agree. The FAA believes that proposed §§ 25.1309(f) and 29.1309(e) are clear in that the monitoring of power loads is allowed in those circumstances and loads not required in controlled flight need not be considered for the two-engine-inoperative condition on airplanes with three or more engines. One commentator objected to the proposed two-engine-inoperative condition on aircraft with three engines on the ground that it would impose a requirement for an unreasonable amount of power, in that both units of dual systems would be required to operate during that condition. The FAA disagrees. The procedure set forth in proposed §§ 25.1309(f) and 29.1309(e), which would apply to the two-engine-inoperative condition on three-engine aircraft, would allow the monitoring of one unit of a dual system in those circumstances. Another commentator objected to proposed § 29.1309 (d)(3)(ii) contending that the requirement was unreasonable for rotorcraft since they cannot maintain flight with only one third of installed power. The FAA does not agree that the requirement is unreasonable for rotorcraft. The proposal would ensure that at least those power loads necessary for controlled descent to a safe landing are supplied for the two-engine-inoperative condition on a three-engine rotorcraft. Accordingly, proposed §§ 25.1309(e)(3) and (f), § 29.1309(d)(3) and the proposed change to § 29.1309(e) are adopted without substantive change.

Proposal 5-23. For a discussion of the comments related to proposed § 25.1321(a) and the withdrawal of that proposal, see Proposal 5-3.

With regard to proposed § 25.1321(e), one commentator suggested that it be revised to apply only to those instruments required under current §§ 25.1303 and 25.1305. The commentator stated that the special lighting provisions that would be required for optional equipment by proposed § 25.1321(e) could be distracting under certain emergencies and could create unnecessary loads on the available power supply. The FAA does not believe that a distinction in this regard is warranted between required and optional instruments. The FAA believes that if a malfunction indicator has been provided for the crew it should be effective under all probable cockpit lighting conditions.

For other comments related to Proposed § 25.1321(e), see Proposal 5-3.

Proposals 5-24 and 2-84. The disposition of the proposals to amend § 25.1329 has been deferred until final rule-making action is taken with respect to the proposals contained in Airworthiness Review Program, Notice No. 7: Airframe Proposals (Notice 75-26; 40 FR 24802; June 10, 1975). See Proposal 5-7.

Proposals 5-25 and 2-85. Several commentators objected to the proposed deletion of the words "or adjacent to" in current § 25.1331(a)(1) contending that it would restrict flexibility in design and that an integral power failure warning would not necessarily increase warning reliability. The FAA believes that a power failure warning device incorporated within the instrument itself, as opposed to an external device, is more likely to be noticed by the pilot, and would be less vulnerable to wiring or connector failures that may result in loss of the warning function.

One commentator suggested that proposed § 25.1331(a)(3) should apply only to those instruments that present primary navigation data, since navigation is conducted primarily with reference to such instruments and duplication of warning on secondary navigation instruments does not necessarily improve warning reliability. The FAA believes that the instruments covered by proposed § 25.1331(a) are all "primary" in the sense implied by the commentator.

Several commentators, referring to proposed § 25.1331(a)(3), stated that the additional mechanisms and devices necessary to meet this requirement would complicate the design of the instrument to the extent that its reliability would be degraded. The FAA believes that a properly designed warning system would not significantly reduce instrument reliability. Instruments having such warning systems have performed reliably in service.

Several commentators contended that a practicable design meeting proposed § 25.1331(a)(3) is not within the state of the art and that in some instances a triple system, with comparators to monitor and compare signals, would be required. The FAA's intent to require no more than a single system for failure warning. Compliance could be shown, in general, without comparators. Such systems are in use today and are well within the state of the art.

One commentator suggested that the visual warning system that would be required by proposed § 25.1331(a)(3) would tend to reduce or eliminate the sound safe practice of pilots cross-checking instruments to authenticate the information presented. The FAA disagrees. The FAA does not believe that the proposed rule would affect the pilot's cross-checking procedures. In addition, the FAA believes that the warning system would reveal unsafe conditions more effectively and, in some instances, would warn of unsafe conditions that cross-checking would not detect.

Accordingly, the proposed change to § 25.1331(a)(1) and the proposed new § 25.1331 (a)(3) are adopted without substantive change.

Disposition of Proposal 2-85 to revise § 25.1331(a)(2) (Notice 75-10) was deferred so that it could be considered in connection with Proposal 5-25. No unfavorable comments were received on the proposal to revise § 25.1331(a)(2); however, the phrase "provided that instrument operation is maintained" is deleted from proposed § 25.1331 (a)(2) since it is superfluous and could be confusing.

Proposal 5-26. One commentator objected to proposed § 25.1333(b), contending that an instrument display essential to the safety of flight should not have to be switched on when needed. Before an instrument can be switched on, the pilot must first recognize the problem, decide what to do, and then act. The result, the commentator stated, is a time delay that cannot be tolerated at certain critical points in flight, such as immediately after takeoff, and immediately before landing, especially during instrument flight conditions. Another commentator stated that crew action should be allowed for the purpose of restoring power supplies, or selecting an alternative information source, or the like, provided that it is not necessary to do so immediately.

In the light of these comments, and after further review, the FAA believes that this proposal may affect safety adversely. Accordingly, proposed § 25.1333(b) is withdrawn. The proposed editorial change to § 25.1333(a) is adopted.

Proposal 5-27. One commentator objected to proposed § 25.1335 on the ground that mode indication other than mode selector switch position would be impractical and too costly a retrofit. The FAA notes that the proposed requirement would apply only to airplanes for which an application for a type certificate is filed after the effective date of this amendment. Consequently, no retrofit is required. The commentator further stated that the probable complexity of the proposed mode indication device could detract from the reliability of the system and that systems already fitted with the proposed mode indication device have not proven to be 100 percent foolproof. With regard to the complexity of the mode indication device, the FAA does not believe that systems now fitted with the proposed mode indication device have suffered a significant loss in reliability. In addition, the proposed mode indication device would greatly increase the probability that the current mode of operation is properly indicated to the flight crew.

One commentator criticized the proposed phrase "independent of the mode selector switch" because it would tend to dictate design. Another commentator objected to the same phrase on the ground that it does not ake into account modern panels which incorporate illuminated mode indications that give positive indication of the selected mode, but are not independent of the mode selector switch since they are incorporated in it. The FAA agrees with these comments. The phrase "independent of the mode selector switch" is deleted from proposed § 25.1335 and another sentence is added thereto reading "Selector switch position is not acceptable as a means of indication."

One commentator objected to proposed § 23.1335 on the ground that some flight director systems are designed so that the position of the mode selector switch is adequate for mode indication. The FAA knows of no flight director system in which the position of the mode selector switch constitutes a reliable indication of the current mode of operation. Service experience has shown that the two do not necessarily agree. This commentator also stated that the proposed requirement is not practical for small airplanes and is not consistent with requirement that apply to other systems on small airplanes. The FAA believes that the hazards associated with incorrect indication of the flight director system's mode of operation warrant the proposed requirement.

Proposal 5-28. For comments related to the proposal to add a new § 25.1351(c), see Proposal 5-9.

Several commentators stated that proposed §§ 25.1351(d) and 29.1351(c) do not conform to the special condition on which they were based, since they would require the aircraft to operate safely for 5 minutes without normal generator or battery power, whereas the special condition allowed the use of battery power. The FAA agrees that proposed §§ 25.1351(d) and 29.1351(c) should be revised for consistency with recently issued special conditions. The proposals are therefore revised by adding, after the word "power" in the first sentence, the parenthetical phrase "(electrical power sources excluding the battery)".

One commentator stated that §§ 25.1351(d) and 29.1351(c) were unreasonable in that they would require compliance at the maximum certificated altitude, with critical type fuel, and after loss of electrical power, which is a combination that has not occurred in service. The FAA believes that this set of conditions could exist in service, and that it must be considered in the interests of safety. One commentator suggested that the phrase "including a wire bundle or junction box fire" in proposed §§ 25.1351(d)(1) and 29.1351(c)(1) be deleted since these are not "single" malfunctions. The FAA does not agree that they should be deleted. The FAA believes that the occurrence of a fire in a wire bundle or in a junction box should be considered in this context as a single event or malfunction, even though it may result in several circuit failures.

One commentator suggested that proposed §§ 25.1351(d) and 29.1351(c) should provide for continued flight after the specified 5 minute interval, The recommended change is beyond the scope of the notice. In addition, the FAA does not have sufficient information at the present time to justify such a requirement.

Another commentator questioned whether engine thrust reduction and descent, or engine(s) flameout, descent, and subsequent engine restart at a reasonable altitude, would meet the requirements of the proposed rule. The FAA believes that proposed § 25.1351(d) provides for the situation described by the commentator as long as the airplane can be operated safely.

One commentator objected to proposed § 29.1351(c), contending that the requirement was unnecessary for rotorcraft and would result in the introduction of electrical systems of unnecessary complexity and increased likelihood of mismanagement. The FAA does not agree. The loss of normal generator power is potentially hazardous in all transport category aircraft and must be considered in electrical system design. As to the effect on electrical system complexity and the probability of mismanagement, the FAA has not observed a significant increase in complexity or cases of mismanagement on aircraft that have already been required to comply under a special condition.

Accordingly, proposed §§ 25.1351(d) and 29.1351(c) (designated as § 29.1351(d) for consistency with § 25.1351) are adopted with the revision discussed herein.

Proposal 5-29. For comments related to proposed §§ 25.1353(c)(1)(i) and 25.1353(c)(6) see Proposal 5-10.

Proposal 5-30. For comments related to the proposal to amend § 25.1401 see Proposal 5-13.

Proposal 5-31. One commentator objected to proposed § 25.1421(a) on the ground that since a megaphone is not required to be designed to withstand the ultimate inertia forces specified in § 25.561(b)(3), the airframe manufacturer cannot guarantee that a megaphone will perform its function after being subjected to those forces. The FAA agrees that the requirement of proposed § 25.1421 that "the megaphone be so protected that it will perform its function after being subjected to the ultimate inertia forces specified in § 25.561(b)(3)" is too restrictive in the absence of appropriate design standards for the megaphone itself. Accordingly, proposed § 25.1421(a) is revised to read, "If a megaphone is installed, a restraining means must be provided that is capable of restraining the megaphone when it is subjected to the ultimate inertia forces specified in § 25.561(b)(3)."

In addition, the FAA notes that current § 25.1561(b) requires that each location, such as a locker compartment, that carries life saving equipment (which includes megaphones) must be marked accordingly. Proposed § 25.1421(b) would add little to that requirement, and could raise questions about the meaning of § 25.1561(b) with respect to other life saving equipment. For these reasons, proposed § 25.1421(b) is withdrawn.

Proposal 5-32. Several commentators objected to proposed § 25.1435(a)(2), contending that pressure and fluid quantity gages are not necessary for all hydraulic systems. Another commentator stated that the proposal specifies a design detail rather than a requirement and would rule out other displays such as digital callouts. After further review, the FAA believes that pressure and fluid quantity gages are not needed for all hydraulic systems covered by proposed § 25.1435(a)(2). Indicating means other than gages, including warning lights, may be adequate for some systems. Accordingly, the lead-in of proposed § 25.1435(a)(2) is revised to require "a means to indicate" instead of a gage, for system pressure and for fluid quantity.

No favorable comments were received concerning proposed § 25.1435(a)(2)(i) and it is adopted without substantive change.

One commentator suggested that the malfunctions referred to in proposed § 25.1435(a)(2)(ii) be limited to those associated with low fluid pressure or level. The FAA does not agree. An indicating means for system pressure and fluid quantity would aid the pilots in detecting malfunctions other than low pressure or low fluid quantity. Proposed § 25.1435(a)(2)(ii) is adopted without substantive change.

One commentator stated that the value of 125 percent in proposed § 25.1435(a)(4) was unrealistic and recommended a value of 133 percent. The FAA disagrees. The 125 percent value is in the current rule and the FAA believes that it is appropriate. Proposed § 25.1435(a)(4)(ii) is adopted without substantive change.

No unfavorable comment was received concerning proposed § 25.1435(a)(7) and it is adopted without substantive change.

One commentator suggested that proposed § 25.1435(a)(8) should be revised to take into account the hazardous effects of system failures due to abnormally high temperatures which may occur under certain fault conditions. The FAA does not have sufficient information at the present time to justify such a requirement. Proposed § 25.1435(a)(8) is adopted without substantive change.

Proposal 5-33. One commentator stated that if the term "components" in proposed §§ 25.1438(a) and (b) included all parts of the system it would not be compatible with other sections of Part 25, which use the term "elements". The FAA intended that the term "components" include all parts of the system. Therefore, in order to be consistent with current § 25.1435, which uses the term "elements", that term is substituted for the term "components" in proposed §§ 25.1438(a) and (b).

Another commentator recommended that the 1.5 factor in proposed § 25.1438(a) be reduced to 1.33 to be consistent with current § 25.365(d), which deals with pressurized cabin loads. The FAA does not agree. The FAA does not believe that the factors specified for pressurized cabin loads are appropriate for pressurization system elements. These elements are move comparable to hydraulic system elements for which a 1.5 factor is prescribed in current § 25.1435(a)(1). Proposed § 25.1438(a) is adopted without substantive change.

One commentator questioned the need to specify a higher burst pressure for pneumatic systems than for pressurization systems, contending that pneumatic systems do not necessarily operate at higher pressure and that some are derived from pressurization systems. The FAA's experience has been that pneumatic systems in airplanes are operated at higher pressures, even when a common pressure source is provided for both pneumatic and pressurization systems.

One commentator objected to the provision in proposed § 25.1438(b) requiring a burst pressure test of 4.0 times maximum normal operating pressure, contending that the industry has historically designed and tested pneumatic systems to a burst pressure of 3.0 times maximum normal operating pressure and that service experience over millions of flight hours has proven the integrity of those systems. Another commentator pointed out that pneumatic deicer boots in general use today cannot sustain a pressure of 4.0 times the maximum normal operating pressure. The FAA agrees with these comments, and proposed § 25.1438(b) is revised to specify a burst pressure of 3.0 times maximum normal operating pressure.

Two commentators recommended that the 4.0 factor in proposed § 25.1438(b) be reduced selectively in particular circumstances, contending that a lower factor might be acceptable for certain materials, or when adequate fatigue testing has been done or service experience supports it. The FAA believes that this recommendation (insofar as it would be applicable to a 3.0 burst pressure factor) may have merit but has insufficient data at the present time upon which to base such lower factors.

Another commentator suggested that the 1.5 factor in proposed § 25.1438(b) should be increased to monitor the effects of manufacturing techniques. The FAA does not agree. These effects are monitored by means of FAA's quality control requirements, as set forth in Part 21.

One commentator suggested revision of proposed § 25.1438 to allow the use of analysis, or a combination of analysis and test, as an alternative method of compliance to eliminate unnecessary testing. The FAA agrees that there are instances where an analysis, or a combination of analysis and test, may be equivalent to a test under proposed § 25.1438(a) or (b). Accordingly, a new § 25.1438(c) is added to provide this alternative.

Proposal 5-34. One commentator objected to the provision in proposed § 25.1447 (c)(1) which would require that oxygen dispensing units be automatically presented before the cabin pressure altitude exceeds 14,000 feet, contending that long-standing FAA policy has been that the altitude for automatic presentation should be 15,000 feet and service experience over the last 16 years has not shown a need to reduce that altitude. The commentator further stated that the flight crew is given a warning when or before the cabin pressure altitude reaches 10,000 feet and is therefore alerted (in the event of a gradual increase in cabin pressure altitude) to the need for appropriate action either to maintain a safe cabin pressure altitude or manually deploy the dispensing units. Another commentator suggested that the presentation altitude be 14,500 feet, rather than 14,000 feet, to take equipment tolerances into account.

In light of the comments received and after further review, the FAA believes that there is insufficient evidence at the present time to justify a requirement for the automatic presentation of oxygen dispensing units before the cabin pressure altitude exceeds 14,000 feet, and that the widely-used value of 15,000 feet provides an adequate level of safety. Proposed § 25.1447(c)(1) is revised accordingly.

Several commentators disagreed with the provision in proposed § 25.1447(c)(1) that would require that each occupant be provided with a manual means to make the oxygen dispensing unit immediately available, contending that manual back-up for the automatic presentation system should be provided for use by the crew only, to avoid tampering by the passengers. Another commentator stated that the average passenger would not be capable of operating such manual means properly and quickly, and that manual means are not feasible for ceiling or hatrack mounted dispensing units.

The FAA believes that a manual means must be provided to back up the automatic presentation system, but is persuaded that it may not be in the interest of safety to require that a manual means be provided for passengers. Accordingly, proposed § 25.1447(c)(1) is revised to require only that a manual means for the development of the dispensing units be provided for the crew.

No unfavorable comment was received concerning proposed § 25.1447(c)(2) and it is adopted as proposed.

Proposal 5-35. Several commentators recommended that proposed § 25.1450 be revised to require a means to indicate that the generator (or replacement element) has not been used and is capable of providing its rated amount of oxygen. The FAA believes that, in view of current § 25.1441(c), there is no need for this additional requirement.

Several commentators objected to proposed § 25.1450(b)(2)(i) on the ground that a positive flow indicating device located on the generator would provide insufficient safety improvement for the cost involved. After further review, the FAA does not believe that there exists adequate justification for the proposed requirement at the present time and it is withdrawn.

One commentator suggested that the word "installation" be added after the word "generator" in the lead-in of proposed § 25.1450(b) because, as proposed, the surface temperature of the actual generator must be contained by its installation. The FAA sees no need for this revision.

One commentator questioned the desirability of replacing generator elements during flight. The FAA believes that the practical problems of manually replacing and stowing expended generator elements, which reach high temperatures, make it very unlikely that generators requiring manual in-flight replacement of elements would be utilized. Instead, generator elements would be replaced during ground maintenance. For this reason, proposed § 25.1450(c)(2) is withdrawn.

One commentator objected to proposed § 25.1450(c)(1)(ii) contending that the proposal should not require that the generator placard contain the duration of the replacement element since a means to determine flow in the dispensing equipment is provided. The FAA does not agree; it is necessary that the duration of the replacement element be on the placard to reduce the probability that an element of insufficient capacity is inserted when the generator is serviced.

Proposal 5-36. Several commentators objected to proposed §§ 25.1457(b) and 29.1457(b). The FAA believes that the comments received raise valid questions as to whether compliance with proposed §§ 25.1457(b) and 29.1457(b) would necessarily improve cockpit voice recorder intelligibility, and whether requiring multiplexing or separate area microphone recording channels (involving extensive redesign of the cockpit voice recorder) could be justified on a cost-benefit basis. Accordingly, proposed §§ 25.1457(b) and 29.1457(b) are withdrawn.

Several commentators objected to proposed §§ 25.1457(d)(1) and 29.1457(d)(1) because the additional load on the emergency bus would reduce the power available to sustain safe flight in an emergency. The FAA agrees, and proposed §§ 25.1457(d)(1) and 29.1457(d)(1) are withdrawn.

Two commentators objected to proposed §§ 25.1457(e) and 29.1457(e) contending that, although the random storage method may have caused problems in earlier years, the cockpit voice recorder manufacturers have since taken steps to eliminate the problem by improvements in design, and there is therefore no justification for specifying that the tape be stored on reels, which is an unnecessarily restrictive requirement. In light of this comment and after further review by the FAA, §§ 25.1457(e) and 29.1457(e) are withdrawn. In view of the withdrawal of proposed §§ 25.1457(b),(d)(1), and (e) and 29.1457(b),(d)(1), and (e) the related provisions of proposed §§ 121.359(c)(3) and (c)(4) and 127.127(b) are also withdrawn.

Several commentators suggested that the underwater locating device specified in proposed §§ 25.1457(g)(3) and 121.359(c)(2)(iii) was superfluous when the flight recorder (which must have an underwater locating device under current § 121.343(f)) and the cockpit voice recorder are co-located. The FAA agrees that an exception is warranted in this circumstance, provided that the installation of the flight recorder and the cockpit voice recorder is such that they are not likely to be separated during crash impact. Accordingly, proposed § 121.359(c)(2)(iii) is adopted with this exception. No revision to proposed § 25.1457(g)(3) is needed and proposed § 25.1457(g) is adopted without substantive change.

Two commentators objected to proposed § 121.359(c)(2) on the ground that up to 3 years would be needed by the airlines to make the airplane modifications prescribed. The FAA agrees, and the lead-in of proposed § 121.359(c)(2) is revised to allow 3 years (from the effective date of this amendment) for compliance. Proposed § 121.359(c) is adopted with the revisions discussed herein.

Proposal 5-37. Several commentators objected to proposed § 25.1459(a)(4), which would require a means for pre-flight checking of the flight recorder for proper operation. One commentator stated it is not technically within the state-of-the-art to meet this test requirement for foil-recording systems, and that the proposed requirement is unnecessarily restrictive. Another commentator contended that there would be a prohibitive increase in flight-crew and ground-crew workload to conduct the proposed test. In light of these comments, and after further review by the FAA, the FAA believes that proposed § 25.1459(a)(4) would be unnecessarily restrictive. Accordingly, proposed § 25.1459(a)(4) is withdrawn.

No unfavorable comments were received concerning proposed § 25.1459(d) and the proposed deletion of current § 25.1459(a)(7). Accordingly, § 25.1459(a)(7) is deleted and proposed § 25.1459(d) is adopted without substantive change. In addition, since the intent of the proposal was that it only apply to airplanes type certificated in the future, § 121.343(e), which requires compliance with the provisions of § 25.1459, is clarified by revising the first sentence of the lead-in to state that the applicable requirements are those of § 25.1459 in effect one day prior to this amendment.

Proposal 5-38. One commentator objected to proposed § 25.1461, contending that there is no need for it since current §§ 25.1309 and 25.901(c) provide adequate coverage for this item. The FAA does not agree. Sections 25.1309 and 25.901(c) list general requirements, the former for all classes of equipment and the latter for powerplant installations. These general requirements do not contain the detailed airworthiness standards specifically applicable to high energy rotors that the FAA believes are necessary for the reasons stated in the explanation of this proposal.

Another commentator suggested that the proposal be clarified as to whether § 25.1461 (a) requires compliance with either paragraph (b), or (c), or (d). The FAA believes that the proposed language is clear in this respect. The applicant is required to comply with one of those paragraphs, and he may select any one of them.

For another comment related to this proposal, see Proposal 5-17.

The proposal to add a new § 25.1461 is adopted without substantive change.

Proposal 5-39. For comments related to proposed § 27.1301 and for the withdrawal of proposed § 27.301, see Proposal 5-1.

Proposal 5-40. For comments related to the proposal to amend § 27.1309(a), and for the withdrawal of this proposal, see Proposal 5-22.

Proposals 5-41 and 2-129. The disposition of the proposals to add new §§ 27.1311 and 27.1329 has been deferred until final rule-making action is taken with respect to the proposals contained in Airworthiness Review Program, Notice No. 7; Airframe Proposals (Notice 75-26; 40 FR 24802; June 10, 1975). See Proposal 5-7.

Proposal 5-42. For comments related to proposed § 27.1321(a), and the withdrawal of proposed § 27.1321(a), see Proposal 5-3.

For comments related to proposed § 27.1321(d), see Proposals 5-3 and 5-23.

Proposal 5-43. For a comment related to the proposal to add a new § 27.1323(a), see Proposal 5-4. No unfavorable comments were received concerning proposed § 27.1323(b). The proposal to amend § 27.1323 is adopted without substantive change.

Proposals 5-44, 2-35, 2-83, 2-128 and 2-183. Several commentators objected to proposed § 27.1325(b) in Proposal 5-44 on the ground that Part 27 rotorcraft are not normally certificated for flight under IFR or icing conditions. Since static vent icing may occur during both VFR and IFR conditions, the FAA believes there is ample justification for requiring an anti-icing means or an alternate source of static pressure for the certification of all rotorcraft employing a static pressure system for required instruments.

One commentator stated that even if a static pressure system failure occurred, it would not jeopardize safe flight and a safe landing. The FAA disagrees. A static pressure failure would result in the loss of reliable airspeed and altitude information.

Another commentator stated that the implication of proposed § 27.1325(b) in Proposal 5-44, when compared with current § 23.1325(b)(3), is that the reading of the altimeter when on the alternate static pressure system cannot differ from the reading of the altimeter when on the primary static pressure system. The FAA agrees and proposed § 27.1325(b) is revised by adding a sentence identical to the last sentence of current § 23.1325(b)(3) which indicates that error is allowed and requires a correction card for errors greater than 50 feet.

Disposition of Proposals 2-35, 2-83, 2-128 and 2-183 to amend §§ 23.1325, 25.1325, 27.1325 and 29.1325, respectively (Notice 75-10) was deferred so that they could be considered in connection with Proposal 5-44.

One commentator stated that proposed § 23.1325(c), which would provide for more complete duality of static pressure sources, should not be applied to unpressurized aircraft if it is demonstrated that the static pressure system calibration, when each static pressure source is selected, is not changed by the other static pressure source being open or blocked.

The FAA believes this suggestion has merit with respect to the proposed requirement that when a static pressure source is selected the other static pressure source must be blocked off. However, the exception would only be appropriate if it is demonstarted that the static pressure system calibration, when each static pressure source is selected, is not changed by the other static pressure source being open or blocked.

Accordingly, proposed §§ 23.1325(c), 25.1325(g), 27.1325(b), and 29.1325(f) (Proposals 2-35, 2-83, 2-128, and 2-183, respectively) are adopted without substantive change (proposed § 27.1325(b) in Proposal 2-128 and proposed § 29.1325(f) in Proposal 2-183 are redesignated §§ 27.1325(c) and 29.1325(g), respectively, in view of the adoption of Proposals 5-44 and 5-57) and new §§ 23.1325(d), 25.1325(h), 27.1325(d), and 29.1325(h) contain the exception discussed here.

Proposal 5-45. For comments related to the proposal to amend § 27.1327, and for an explanation of revisions to current § 27.1327(a) and proposed §§ 27.1327(b) and (c), see Proposal 5-6.

Proposal 5-46. For comments related to the proposal to add a new § 27.1335, and for an explanation of the revisions to proposed § 27.1335, see Proposal 5-27.

Proposal 5-47. For comments related to the proposal to add a new § 27.1351(e), see Proposal 5-9.

Proposal 5-48. For comments related to proposed §§ 27.1353(b)(1) and 27.1353(g), see Proposal 5-10.

Proposal 5-49. No unfavorable comments were received on the proposal to amend § 27.1357(b). Accordingly, the proposal is adopted without substantive change.

Proposal 5-50. The proposed amendment of § 27.1401 relating to anticollision light field of coverage, color, and minimum intensity requirements has been adopted, with revisions, in a separate rule-making action (Amdt. 27-10; 41 FR 5290), as noted previously in this preamble.

Proposal 5-51. The disposition of the proposal to amend § 27.1545 has been deferred until final rule-making action is taken with respect to the proposals contained in Airworthiness Review Program, Notice No. 7; Airframe Proposals (Notice 75-26; 40 FR 24802; June 10, 1975). See Proposal 5-18.

Proposal 5-52. For comments related to the proposal to add a new § 27.1547(e), and for an explanation of the revisions to proposed § 27.1547(e), see Proposal 5-19.

Proposal 5-53. For comments related to proposed § 29.1301 and for the withdrawal of proposed § 29.1301, see Proposal 5-1.

Proposal 5-54. One commentator questioned the exception in proposed § 29.1303(g) in that it only applies to those rotorcraft with a third attitude indicating system and does not apply to those rotorcraft that are only required to have one attitude indicating system but have two. The FAA does not have sufficient information at this time to justify extending the proposed exception, as recommended by the commentator.

Another commentator suggested that the 30-minute minimum interval specified in proposed § 29.13030(g)(3) should be changed to "half the endurance of the rotorcraft". The FAA believes the proposed requirement would give the flight crew sufficient time to take corrective action, or land, as the situation may dictate.

Accordingly, § 29.1303(g) is adopted as proposed.

Proposal 5-55. For comments related to the proposal to amend § 29.1309, see Proposal 5-22.

Proposal 5-56. For comments related to proposed § 29.1321(a) and the withdrawal of proposed § 29.1321(a), see Proposal 5-3.

For comments related to proposed § 29.1321(g), see Proposals 5-3 and 5-23.

Proposal 5-57. For comments related to proposed § 29.1325(c), see Proposal 5-44. In light of the comments received and after further review, the FAA believes that there is not sufficient justification to adopt a requirement for Part 29 rotorcraft that is more restrictive than that in proposed § 27.1325(b) for Part 27 rotorcraft. Accordingly, proposed § 29.1325(c), as adopted, is revised to be substantively identical to § 27.1325(b) as adopted.

Proposals 5-58 and 2-184. The disposition of the proposals to amend § 29.1311 has been deferred until final rule-making action is taken with respect to the proposals contained in Airworthiness Review Program, Notice No. 7: Airframe Proposals (Notice 75-26; 40 FR 24802; June 10, 1975). See Proposal 5-7.

Proposal 5-59. For comments related to the proposal to add a new § 29.1335, and for an explanation of the revisions to proposed § 29.1335, see Proposal 5-27.

Proposal 5-60. For comments related to the proposal to add a new § 29.1351(c), see Proposal 5-28. For comments related to the proposal to add a new § 29.1351(d), see Proposal 5-9.

Proposal 5-61. For comments related to proposed §§ 29.1353(c)(1)(i) and 29.1353 (c)(6), see Proposal 5-10.

Proposal 5-62. A commentator suggested that it would be more appropriate to cover the content of proposed § 29.1355(b)(1) in § 29.1309 or § 29.1351. The FAA does not agree. Proposed § 29.1355(b)(1) states a requirement concerning distribution systems and distribution systems are the subject matter of current § 29.1355. Accordingly, § 29.1355(b)(1) is adopted without substantive change.

Proposal 5-63. The proposed amendment of § 29.1401 relating to anticollision light field of coverage, color, and minimum intensity requirements has been adopted, with revisions, in a separate rule-making action (Amdt. 29-11; 41 FR 5290, as noted previously in this preamble.

Proposal 5-64. For comments related to the proposal to revise §§ 29.1457(b),(d)(1), and (e), and for the withdrawal of that proposal, see Proposal 5-36.

Proposal 5-65. The disposition of the proposal to amend § 29.1545 has been deferred until final rule-making action is taken with respect to the proposals contained in Airworthiness Review Program, Notice No. 7: Airframe Proposals (Notice 75-26; 40 FR 24802; June 10, 1975). See Proposal 5-18.

Proposal 5-66. For a comment related to the proposed revision of § 91.33(d)(3), see Proposal 5-54.

Section 91.33(d)(3) is adopted as proposed.

Proposal 5-67. One commentator objected to the proposal to amend § 91.36 because he believed it would allow compliance with either current § 91.36(b) or proposed § 91.36(c). The commentator misinterpreted the proposal. The proposal would require compliance with § 91.36(a), (b), and (c).

Another commentator contended that the term "performance standards" in proposed § 91.36(c) would cause confusion and suggested that the word "performance" be deleted. Since the intent of the proposal was to require compliance with all of the minimum standards in the specified TSOs, the FAA agrees with the comment and the word "performance" is deleted in the amendment.

Two commentators suggested revisions to proposed § 91.36(c) that would, in effect, allow the continued operation of currently installed pressure altitude reporting equipment using altimeters and digitizers that do not meet the standards in TSO-C10b and TSO-C88 respectively. The FAA believes that unless these standards are met, there is not assurance that altimeters and digitizers will perform their important probable operating conditions during flight. For this reason, that commentators' suggestion is not adopted. However, after further consideration, the FAA believes that the proposed one-year installation period (after the effective date of the amendment) may not allow enough time to procure and install altimeters and digitizers which comply. Accordingly, the amendment as adopted prescribes a two-year installation period.

One commentator recommended that proposed § 91.36(c) be revised by replacing the term "digitizers" with the term "automatic pressure altitude digitizer equipment" (which is the complete term used in current TSO-C88) because the use of the term "digitizers" would allow approval of equipment that did not meet the standards in TSO-C88. The FAA does not believe that the recommended revision is necessary. It is clear that the equipment referred to must meet the standards in TSO-C88.

The proposal to amend § 91.36 is adopted with the revisions discussed herein.

Proposal 5-68. After further consideration of the proposal to amend § 121.337, and in light of the comments received, the FAA believes that the issues involved warrant further study. Accordingly, the proposal to amend § 121.337 is withdrawn.

Proposal 5-69. Several commentators objected to proposed § 121.343(a). The objections included the following:

- Each new airplane design is sufficiently different to preclude identifying identical components, and system status, that would have the same effect upon controlled flight.
- Flight recorders meeting the current requirements are providing the answers for accident investigation. There is no hard evidence that additional parameters are needed.
- The proposed additional parameters represent a growth of over 100 percent in existing flight recorder systems, with a corresponding growth in system complexity. The result would be a sharp decrease in the reliability of not only the flight recorder but also of the equipment monitored, much of it essential to safe flight.
- The proposed additional parameters would require the installation of systems and components of major cost whose sole purpose is to aid accident investigation. One commentator estimated that the modification program would cost the airline industry $35 million, including airplane out-of-service costs. There would also be greatly increased maintenance costs because of the increased complexity of the system.
- The proposed additional parameters have not been justified on a cost-benefit basis, and no rationale has been given to justify the selection of the proposed parameters from all of the parameters that could be recorded.
- Although some of the proposed additional parameters may enhance the recording system, the implementation of even these would take at least three years.
- The proposal does not provide ranges, accuracies, or recording intervals for the additional parameters.

In the light of these comments, and after further review, the FAA believes that the need for the proposed additional flight recorder parameters has not been justified. Moreover, the FAA now believes that standards setting forth acceptable ranges, accuracies, and recording intervals, for such additional parameters should be developed concurrently with the requirement that they be provided.

Accordingly, proposed § 121.343(a) is withdrawn.

Proposal 5-70. For comments related to the proposal to revise § 121.359(c) and for an explanation of the revisions to proposed § 121.359(c), see Proposal 5-36.

Proposal 5-71. For comments related to the proposal to revise § 127.127(b) and for the withdrawal of that proposal, see Proposal 5-36.

DRAFTING INFORMATION

The principal authors of this document are Irving Fagin, Flight Standards Service, and James M. Barron and Keith S. May, Office of the Chief Counsel.

ADOPTION OF THE AMENDMENTS

Accordingly, Parts 23, 25, 27, 29, 91, and 121 of the Federal Aviation Regulations (14 CFR Parts 23, 25, 27, 29, 91, and 121) are amended as follows, effective September 1, 1977.

(Secs. 313(a), 601, 603, 604, and 605 of the Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421, 1423, 1424, and 1425); and the sec. 6(c) of the Department of Transportation Act (49 U.S.C. 1655(c)).)

NOTE.—The Federal Aviation Administration has determined that this document does not contain a major proposal requiring preparation of an Economic Impact Statement under Executive Order 11821, as amended by Executive Order 11949, and OMB Circular A-107.

Amendment 27-14

Airworthiness Review Program

Amendment No. 6: Flight Amendments

Adopted: January 9, 1978 **Effective: March 1, 1978**

(Published in 43 FR 2302, January 16, 1978)

SUMMARY: The purpose of these amendments to the Federal Aviation Regulations is to update and improve—(1) the airworthiness standards applicable to aircraft performance, flight characteristics, flight manuals, and operating limitations; (2) the operating rules containing related airworthiness standards; and (3) the rules governing holders of type certificates. These amendments are part of the Airworthiness Review Program.

FOR FURTHER INFORMATION CONTACT:

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SUPPLEMENTARY INFORMATION: These amendments are the sixth in a series of amendments to be issued as part of the Airworthiness Review Program. The following series of amendments have previously been issued as part of this Airworthiness Review Program:

Title	*FR citation*
Form number and clarifying revisions.	(40 FR 2576; Jan. 14, 1975).
Rotorcraft anticollision light standards.	(41 FR 5290; Feb. 5, 1976).
Miscellaneous amendments.	(41 FR 55454; Dec. 20, 1976).
Powerplant amendments.	(42 FR 15034; March 17, 1977).
Equipment and systems amendments.	(42 FR 36960; July 18, 1977).

These amendments are based on two Notices of Proposed Rule Making—Notice 75-10 published in the FEDERAL REGISTER on March 7, 1975 (40 FR 10802); and Notice 75-25 published in the FEDERAL REGISTER on June 9, 1975 (40 FR 24664). The amendments based on Notice 75-10 were deferred in the series of amendments titled "Miscellaneous Amendments" so that they could be considered with the final disposition of certain proposals in Notice 75-25. The discussions of the comments received for the deferred proposals are included under the heading of the related Notice 75-25 proposals.

Interested persons have been afforded an opportunity to participate in the making of these amendments and due consideration has been given to all matters presented. A number of substantive changes and changes of an editorial and clarifying nature have been made to the proposed rules based upon relevant comments received and upon further review within the FAA. Except for minor editorial and clarifying changes and the substantive changes discussed below, these amendments and the reasons for them are the same as those contained in Notices 75-10 and 75-25.

DISCUSSION OF COMMENTS

The following discussion is keyed to the like-numbered proposals contained in Notice 75-25.

Proposal 6-1. No unfavorable comments were received on the proposal to amend § 1.1 by deleting the term "Accelerate-stop distance" and its definition. Accordingly, the proposal is adopted without substantive change.

Proposal 6-2. For a comment related to the proposal to amend § 1.2, see Proposal 6-34.

Proposal 6-3. One commentator suggested that proposed new § 21.5 concerning Airplane and Rotorcraft Flight Manuals be revised to make clear that other titles for the required Flight Manual, such as Pilot's Operating Handbook, will continue to be approved. The FAA has no objection to the use of the term Pilot's Operating Handbook as the main title. However, if an applicant chooses to use the title Pilot's Operating Handbook, he must include a statement on the title page indicating that the document is the FAA-required Airplane or Rotorcraft Flight Manual.

The same commentator pointed out that on airplanes of types for which Flight Manuals were not furnished in the past, much of the required information was furnished on placards and markings, and that, if this proposal is adopted, some of the placards would no longer be needed but would still be part of the airplane's certification basis. The FAA agrees that some placards may not be necessary after the information is furnished in a Flight Manual. However, application may be made to change the type design if the applicable regulations only require that the material be in either a Flight Manual or in any combination of approved manual materials, markings, and placards.

The same commentator also stated that proposed § 21.5(b) would penalize airplanes that were designed and tested to temperatures higher than the hot day condition prescribed in § 23.1043(b)(1). The FAA does not agree because the temperature for which cooling was demonstrated would be furnished in the Flight Manual as information, not as a limitation. It should be noted that, in response to Proposal 6-29, this commentator stated that there is no objection to furnishing the test temperature if it is not a limitation.

Two commentators stated that it should be made clear that, for rotorcraft originally certificated with a flight manual, the manual originally approved need not be revised to include the new requirements of this proposal. The FAA does not believe a revision is necessary since proposed § 21.5(b), in conjunction with proposed § 21.5(a), refers only to airplanes or rotorcraft that were not type certificated with an Airplane or Rotorcraft Flight Manual.

Another commentator said that requiring Flight Manuals to be furnished for aircraft previously type certificated without a Flight Manual places too large a burden on the holders of these type certificates. The FAA does not agree since the information to be included in the Flight Manual has already been furnished in other forms. In addition, a Flight Manual would provide the operator with essential information in a consolidated, organized form suitable for study and reference. The FAA believes that these benefits outweigh the burden of preparing and printing the Manual.

One commentator, who concurred with the proposal, recommended that the turbulent air penetration speed, least angle of glide speed, and least rate of descent speed (power off) be added to the required information. These are specific requirements which are not applicable to all categories of aircraft and the FAA does not believe they should be included in the rule.

The phrase "maximum anticipated air temperature" in proposed § 21.5(b)(2) is deleted and the phrase "maximum ambient atmospheric temperature" is inserted in its place to be consistent with Proposal 6-20 to amend § 23.1043 and the corresponding proposals for the other certification parts, which are being adopted in this series of amendments.

The proposal to add a new § 21.5 is adopted with the revision discussed above.

Proposal 6-4. For comments related to the proposal to amend § 23.25(b), see Proposal 6-5. The proposal to amend § 23.25(b) is adopted without substantive change.

Proposal 6-5. One commentator objected to the proposal to amend § 23.29, which would require the empty weight to be determined with "full" operating fluids, on the ground that this procedure would eliminate the option of "off loading" oil in order to maintain weight and center of gravity limits. The FAA does not agree. This option would not be eliminated by proposed § 23.29 since it merely establishes a new reference basis for empty weight. The same commentator stated that since this proposed rule is not retroactive, confusion will result because some aircraft will have oil included in the weight and balance and others will not. This commentator also suggested that the use of the same definition of empty weight by the FAA and the military would eliminate the difficulties encountered by pilots operating both military and civil aircraft. The FAA does not believe that the proposed change will cause confusion or difficulty in either situation cited by the commentator since the weight and balance data accompanying each airplane will specify whether oil is included in the empty weight. Further, this procedure should simplify weight and balance computations since fluids normally included will be accounted for without further additions to the empty weight.

One commentator objected to the proposals to amend §§ 27.29 and 29.29 on the ground that there is no benefit to be gained by changing the definition of empty weight. The FAA does not agree with this comment for the reasons stated in the Notice for these proposals. This commentator further objected to the proposal to amend § 27.29 on the ground that it would create a problem for helicopters that have a larger oil tank capacity than is required under all conditions, such as helicopters designed to accept auxiliary fuel tanks. The option of off-loading oil would not be eliminated by proposed § 27.29. In addition, the FAA believes that the change will accomplish its purpose of simplifying weight and balance computations for the great majority of helicopters.

Several commentators on the proposal to amend § 25.29 noted that the proposed rule would require certain fluids which, in transport category airplanes, are variable as a function of individual operator or mission requirements and of passenger seating density (such as potable water and lavatory pre-charge fluids) to be included in the empty weight. It was suggested that an exception be provided for those fluids that vary with operation or mission as well as those that are expendable in flight such as water intended for injection in the engines. The FAA believes that exceptions for the specific fluids noted are warranted for airplanes, but the FAA does not believe that an exception is appropriate for potable water or lavatory pre-charge water for rotorcraft. The proposals to amend §§ 23.29 and 25.29 are revised accordingly.

Proposal 6–6. A commentator objected to the proposed change to § 23.45, stating that a requirement to correct the performance to 80 percent relative humidity is not necessary, that it would increase the cost and complexity of certification without any increase in safety, and that it will create a new standard atmosphere that will result in confusion as to the basis for engine performance data. The power loss that is associated with changing from dry air to air at 80 percent relative humidity would cause a significant reduction in the climb performance of a reciprocating-engine powered airplane and should be considered. This reduction would be most evident where performance is marginal, e.g., during one-engine-inoperative climb. With regard to turbine engines, the FAA believes that the effect of humidity may be negligible on some types of engines, in which case no performance correction would be necessary. However, for some other types of turbine engines, a correction for humidity will increase the accuracy of the performance data. The FAA believes that the data required for making the corrections can be obtained simply and with inexpensive instrumentation. Further, the FAA does not believe that requiring a correction for humidity in the performance data for newly type-certificated airplanes will result in confusion. A transition period may exist during which the performance data for newly type-certificated airplanes will be corrected for humidity and that for other airplanes may not be. Such transition periods inevitably occur with the adoption of new regulatory provisions and the FAA does not believe that the transition in this case will present a significant problem.

The commentator further stated that present performance measurement accuracy is within the range of uncontrolled airplane-to-airplane variations, atmospheric variations other than humidity, and piloting variations, and that eliminating one variable whose effect is within the spread of other variables is not justifiable on a simple cost-benefit analysis. The FAA does not agree that the humidity correction should be omitted on the basis of conjecture that other variables may mask its effect. Certification flight testing is not allowed when atmospheric variables would affect data accuracy, and tests must be repeated as necessary to establish confidence in data accuracy.

In regard to the burden of correcting for humidity in type certification, the FAA believes that it should in many cases be possible to show that the effect of humidity is not significant or that it is covered by a conservative correction factor. Correction of performance data to standard atmospheric conditions of temperature and pressure is required in any case, and an additional correction for humidity should be a relatively small burden.

The proposal for § 23.45 is adopted without substantive change.

Proposal 6–7. No unfavorable comments were received on the proposal to amend § 23.49. Accordingly, the proposal is adopted without substantive change.

Proposal 6–8. One commentator suggested that, for consistency with certain foreign requirements, proposed §§ 23.51(c)(1)(ii) and (c)(2)(i) should be revised to read 1.2 V_{S_1}, instead of 1.3 V_{S_1}. The FAA does not believe that the recommended change is necessary. Proposed §§ 23.51(c)(1)(ii) and (c)(2)(i) already provide for a speed less than 1.3 V_{S_1}.

The first commentator also stated that proposed § 23.51(c)(1)(ii) should be revised so that it refers to the complete failure of a single engine (on multi-engine airplanes) instead of complete engine failure which would introduce a double failure concept not inherent in these rules. The FAA does not agree. Proposed § 23.51(c)(1)(ii), which is consistent with current § 23.51(a)(2)(ii) in this regard, only requires that "complete engine failure" be investigated if a speed of less than 1.3 V_{S_1} is demonstrated at a height of 50 feet. In addition, current § 23.51(a)(2)(ii) has been consistently interpreted to require that for multi-engine airplanes which meet the powerplant isolation requirements of § 23.903(c) in the takeoff configuration, only one engine need be made inoperative in the specified investigations.

One commentator objected to the extension of takeoff performance determination requirements to airplanes of 6,000 pounds and less maximum weight, for reasons stated in his comments on Proposal 6-3 concerning Flight Manuals. For a discussion of these comments, see Proposal 6-3.

Another commentator recommended that those provisions of the existing rule which relate to nosewheel and tailwheel liftoff speeds be retained and that their applicability be extended to all airplanes. These provisions were originally imposed in lieu of a requirement for approved takeoff performance data for airplanes of 6,000 pounds and less maximum weight. In view of the requirements which are being adopted, and in view of satisfactory service history for airplanes of more than 6,000 pounds maximum weight, the FAA does not believe these provisions should be retained or that their applicability should be extended to all airplanes.

The proposal to revise § 23.51 is adopted without substantive change.

Proposal 6-9. One commentator objected to the application of proposed § 23.65, concerning all-engines operating climb requirements, to airplanes of 6,000 pounds or less maximum weight for reasons stated in his comments on Proposal 6-3 concerning Flight Manuals. For a discussion of these comments, see Proposal 6-3.

Another commentator stated that use of a reduced propeller pitch under proposed § 23.65(b) is not consistent with safety requirements, because it would either deny the pilot performance in actual operation or the protection of limiting the engine to a safe speed. The FAA does not agree. Present § 23.33 defines the pitch and speed limitations for propellers which are to be used in service. Proposed § 23.65(b), which is identical to the present § 23.65(a)(2), merely authorizes the use of a special test propeller pitch setting if it is necessary to obtain rated engine r.p.m. at V_x.

In proposed § 23.65(c), reference to the airplane configuration was inadvertently omitted. The configuration should be the same as that specified in proposed § 23.65(a), and proposed § 23.65(c) is therefore revised to state that the climb gradient is to be met with the airplane in the configuration prescribed in paragraph (a). In addition, § 23.65(a)(4) is revised to cover means other than cowl flaps for controlling the engine cooling air supply. This change is necessary to provide for turbine engines. The proposal to revise § 23.65 is adopted with the revisions discussed above.

Proposal 6-10. One commentator suggested that a speed to be used in calculating the climb gradients should be specified in proposed § 23.67(c) for purposes of uniformity, but did not make a specific proposal. The FAA believes that the applicant should be allowed to select a climb speed if the airplane meets the minimum gradient and rate of climb at that speed. The proposal to amend § 23.67 is adopted without substantive change.

Proposal 6-11. One commentator objected to the application of proposed § 23.75, concerning landing distance requirements, to airplanes of 6,000 pounds or less maximum weight for reasons stated in his comments on Proposal 6-3 concerning Flight Manuals. For a discussion of these comments, see Proposal 6-3. This commentator also stated that proposed § 23.75(e), concerning wheel brake pressures, is a design requirement and should therefore be placed in Subpart D of Part 23. The FAA does not agree because proposed § 23.75(e) refers to the pressures used in determining the landing performance. The commentator further suggested that the FAA should consider issuing advisory material as to what is considered safe and reliable under proposed § 23.75(f). The wording of proposed § 23.75(f) is the same as that of present § 25.75(b)(3), and this wording has been administered without difficulty for many years. However, the FAA will consider issuing advisory material at a future date if the need is shown.

Another commentator stated that he would not support the inclusion of reverse thrust as an acceptable "other means" of retarding the airplane in determining the landing distance under proposed § 23.75(f), because the landing distance is demonstrated on a dry runway with no provision for a field length factor. The FAA agrees that the effect of wet runways would have to be taken into account in any determination that a means of retarding the airplane is safe and reliable and that consistent results can be expected in service use. It should be noted that proposed § 23.1587(a((6) (Proposal 6-31), as adopted, requires that the kind of surface used in the landing distance tests be described in the Airplane Flight Manual. The proposal to revise § 23.75 is adopted without substantive change.

Proposal 6-12. One commentator objected to the application of proposed § 23.77, concerning balked landing performance, to airplanes of 6,000 pounds or less maximum weight for reasons stated in his comments on Proposal 6-3 concerning Flight Manuals. For a discussion of these comments, see Proposal 6-3. Proposed § 23.77 is adopted without substantive change.

Proposals 6-13 and 2-6. One commentator stated that the option in proposed (and current) § 23.149(a) for the applicant to choose zero yaw or an angle of bank is inconsistent because straight flight with zero yaw (zero sideslip) can only be achieved with some degree of bank. The FAA agrees that bank may be needed to establish straight flight with zero yaw following the failure of a powerplant at low airspeed. The proposed language is the same as that of the current rule and an angle of bank of up to 5 degrees to maintain straight flight has been allowed under the current rule. The directional controllability that must be provided for compliance with §§ 23.147 and 23.205 ensures that bank angles up to 5 degrees under these flight conditions will not be accompanied by excessive yaw angles. Certain design or control features may influence the use of roll control immediately following the failure of a powerplant. Therefore, the proposal (as well as the current rule) allows reference to a zero yaw angle, without bank, for determining the V_{MC} of airplanes which incorporate such features.

Section 23.149(a) is revised in accordance with the discussion of Proposal 6-41 with respect to the modes of failure which must be simulated in demonstrating V_{MC}. The revision requires that the method used to simulate critical engine failure must represent the most critical mode of powerplant failure with respect to controllability that is expected in service, rather than (all) modes of powerplant failure expected in service.

Proposal 2-6 to amend § 23.149(b) (Notice 75-10) was reproposed in Proposal 6-13 for the purpose of clarity. No unfavorable comments were received on proposed §§ 23.149 (b),(c), and (d), and they are adopted without substantive change.

Proposal 6-14. One commentator objected to the application of proposed § 23.161 to airplanes of 6,000 pounds and less maximum weight for reasons stated in his comments on Proposal 6-3 concerning Flight Manuals. For a discussion of these comments, see Proposal 6-3.

Since § 23.21(a) requires that each requirement of this subpart must be met at each appropriate combination of weight and center of gravity within the range of loading conditions for which certification is requested, proposed § 23.161(a)(2)(ii) is revised by deleting the reference to center of gravity and proposed § 23.161(c)(2)(iii) is withdrawn.

Proposal 6-15. No unfavorable comments were received on the proposal to amend § 23.177. Accordingly, the proposal is adopted without substantive change. For comments related to the proposal to amend § 23.177, see Proposal 6-16.

Proposal 6-16. One commentator objected to proposed § 23.181(b), which would require that short period lateral or directional oscillations and combined lateral-directional oscillations ("Dutch roll") be damped to $\frac{1}{10}$ amplitude in 7 cycles. The commentator stated that this proposal is more stringent with regard to combined lateral-directional oscillations than proposed § 25.181 (Proposal 6-43) and that proposed § 25.181 retains certain necessary requirements for other short period oscillations that are not contained in proposed § 23.181. Proposed § 25.181(a) would require that oscillations other than combined lateral-directional oscillations be heavily damped, and proposed

§ 25.181(b) would require combined lateral-directional oscillations to be positively (but not heavily) damped. The FAA agrees that a similar distinction should be made in § 23.181 between combined lateral-directional ("Dutch roll") oscillations and other longitudinal, lateral, and directional oscillations.

Current §§ 23.177(a)(4) and (b)(3) (which are deleted by Proposal 6–15) require any short period lateral or directional oscillation to be heavily damped. After considering the comment and after further review, the FAA believes that the current requirement for heavy damping should be retained for short period lateral and directional oscillations other than "Dutch roll" (combined lateral-directional) oscillations. With respect to combined lateral-directional oscillations, the FAA believes that these oscillations do not need to be heavily damped and that the proposed requirements for Part 23 airplanes would provide a satisfactory damping ratio.

The FAA believes the difference between Part 23 and Part 25 requirements with respect to combined lateral-directional oscillations is justified since airplanes certificated under Part 25 have very large variations in size, weight, and moment of inertia, which affect the lateral-directional characteristics and pilot reaction to these characteristics. The FAA therefore believes that it is appropriate that the damping requirement in § 25.181(b) be stated in general terms, as reflected in Proposal 6–43.

The proposal to amend § 23.181 is adopted with the revisions discussed above.

Proposal 6–17. Proposed new § 23.183 would establish a limit on the rate of spiral divergence by requiring that the angle of bank may not increase to more than 40 degrees in less than 12 seconds after the controls are released in a 20-degree banked turn under specified conditions. One commentator objected to the proposal stating that no need had been shown for the proposal and that the tests referred to in the notice were not definitive. After comparing available data on the subject of spiral divergence, the FAA believes that rulemaking on this subject is premature. Accordingly, the proposal to add a new § 23.183 is withdrawn.

Proposal 6–18. Many comments were received on the proposal to amend § 23.221. In view of the conflicting views expressed in these comments, and after further consideration by the FAA, the FAA believes that the proposal to amend § 23.221 is premature, and it is withdrawn.

Proposal 6–19. One commentator stated that the proposal to amend § 23.729(f)(1) is redundant and that the requirement proposed is already in effect. The FAA does not agree with the comment for the reasons stated in the notice.

The proposal to amend § 23.729(f)(1) is adopted as proposed except that the last three words, "the aural warning", of the proposed sentence are replaced with the words "the warning device" so that the wording of the sentence is consistent with the remainder of § 23.729(f).

For other comments related to the proposal to amend § 23.729, see Proposal 6–51.

Proposal 6–20. For comments related to the proposal to revise § 23.1043(b), see Proposal 6–23.

Proposal 6–21. One commentator objected to the proposal to amend § 23.1047 for reasons stated in his comments on Proposal 6–3, concerning Flight Manuals. For a discussion of these comments, see Proposal 6–3. The proposal to amend § 23.1047 is adopted without substantive change.

[For discussion concerning new § 23.1353(g), see Proposals 6–57 and 2–87.]

Proposal 6–22. No unfavorable comments were received on the proposal to revise § 23.1501. Accordingly, the proposal is adopted without substantive change.

Proposal 6–23. The proposal to revise § 23.1521(e) is one proposal in a series of proposals on powerplant cooling requirements and ambient temperature operating limitations and information for Parts 23, 25, 27, and 29 aircraft. This series consists of proposals 6–20, 6–23, 6–29, 6–52, 6–54, 6–56, 6–68, 6–71, 6–74, 6–82, 6–85, and 6–88.

Proposed § 23.1521(e) in conjunction with proposed § 23.1043(b) (Proposal 6–20) would require that an ambient temperature operating limitation be established as the maximum atmospheric temperature at which compliance with the powerplant cooling requirements is shown. In response to these proposals, one commentator stated that no justification for safety or other reasons has been presented for establishing the proposed operating limitations, and that he believes that no safety justification exists. The commentator also stated that the FAA cooling tests and correction factors are very conservative, that it would be necessary to correct cooling tests to at least the equivalent of 125 degrees F at sea level to avoid restrictive operating limitations, and that this would result in increased cooling drag and poorer performance. Another commentator, in regard to proposed § 27.1521(f) (Proposal 6-71), also stated that an ambient temperature limitation has not been shown to be necessary.

After considering these comments, and after further review, the FAA believes that it does not now have enough information to justify the proposed requirements for reciprocating engines in Part 23 airplanes and Part 27 rotorcraft. However, because of the differences between reciprocating and turbine engine installations, particularly in regard to engine components and accessories, and because of the effects of high temperature operation on turbines, Part 23 already requires the establishment of ambient temperature limitations for turbine engines, and for the same reasons the FAA believes that ambient temperature limitations for turbine engines should also be established for Part 27 helicopters. Parts 25 and 29 already require temperature limitations for reciprocating engines (as well as turbine engines) because the reciprocating engines in these aircraft are generally more complex than those used in Part 23 and Part 27 aircraft.

Accordingly, proposed §§ 23.1521(e) and 27.1521(f) are revised to require the establishment of ambient atmospheric temperature limitations for turbine but not for reciprocating engines and proposed §§ 25.1521(e) and 29.1521(e) are adopted without substantive change. In addition, proposed §§ 23.1043(b), 25.1043(b), 27.1043(b), and 29.1043(b), as adopted, are revised to omit the reference to a limitation on the operation of the aircraft, since the establishment of ambient temperature operating limitations is prescribed in proposed §§ 23.1521(e), 25.1521(e), 27.1521(f), and 29.1521(e). For reciprocating engines, §§ 23.1587 and 27.1587 are revised to require that the maximum ambient air temperature for which compliance with the eengine cooling requirements was shown must be included in the performance information section of the Flight Manual.

One commentator recommended that the 100-degrees F minimum in proposed § 25.1043 (b) be deleted, since the ambient temperature at which compliance with the cooling requirements is shown becomes an operating limitation on the airplane and airworthiness is not affected as long as the limitation is followed. The FAA believes that the 100-degree F minimum is appropriate since a lower temperature would be impractical and unrealistic considering summer operations in the United States. It should be noted that an exception to the minimum is provided for winterization installations.

This commentator also stated that the explanation for proposed § 25.1043(b) implies that only a test demonstration at 100 degrees F or higher is acceptable. This is incorrect. Section 23.1043(a)(1) and corresponding provisions in Parts 25, 27, and 29 clearly indicate that tests may be conducted under other conditions and corrected to the prescribed conditions.

One commentator recommended the deletion of the requirements in proposed §§ 27.1583(b) and 29.1583(b) for an explanation of the powerplant limitations in the Airplane Flight Manual, since such explanations would be redundant. A similar comment was received in response to proposed § 25.1583(b). The intent of the proposals was not to require an explanation of each limitation. A separate explanation would not be necessary for a limitation that is self-explanatory. For clarification, proposed §§ 23.1583(b)(2), 25.1583(b)(2), 27.1583(b)(2), and 29.1583(b)(2) are revised to require an explanation of limitations "when appropriate."

In regard to proposed § 23.1583(b), one commentator stated that contrary to the FAA statement in the notice, the establishment of the test temperature as a limitation has not been required in the past and should not be a limitation. The FAA disagrees. Current § 23.1583(j) requires that, for turbine engines, the temperatures used in the climb test prescribed in § 23.1043(b)(2), be furnished as operating limitations in the Airplane Flight Manual. Proposed § 23.1583(b) merely makes it clear that any operating limitations that are established under § 23.1521 must be furnished in the Airplane Flight Manual. In view of the adoption of proposed § 23.1583(b) as revised, § 23.1583(j) is deleted and marked "Reserved."

With regard to the proposal to amend § 25.1583 (Proposal 6-56), one commentator recommended the deletion of proposed paragraph (b)(3) concerning powerplant limitations, and paragraph (i) concerning maneuvering load factors. The commentator stated that if the engine instrument markings have to be changed, it should be handled by a service bulletin. The FAA does not agree. The relation between the powerplant limitations and the instrument markings should be explained in the Manual. The commentator also stated that the load factor (number) is meaningless to the pilot as he cannot determine what it is during a pull-up maneuver. He stated that correlation with bank angle is acceptable, but that transport aircraft do not exceed 60 degree bank angles. The FAA believes that the maneuvering load factor should be retained in the Flight Manual because it is established as an operating limitation under § 25.1531, and the correlation with bank angle provides useful information to the pilot concerning the strength limitations of the airplane.

The proposals to amend §§ 23.1583, 25.1583, 27.1583 and 29.1583 are adopted with the revision discussed above.

For consistency in the terminology used in the cooling tests requirements, a nonsubstantive change is being made to §§ 23.1043(a)(1), 23.1043(d), 27.1043(a)(1), 27.1043(d), 29.1043(a)(1), and 29.1043(d) by deleting the words "maximum anticipated air temperature" and inserting in their place the words "maximum ambient atmospheric temperature".

Proposal 6-24. One commentator objected to proposed § 23.1523, which concerns the establishment of the minimum flight crew, stating that it is not necessary to make all aircraft conform to the requirements of Part 25. The FAA believes that proposed § 23.1523 specifies the appropriate requirement that should be considered in determining the minimum flight crew for Part 23 airplanes.

Another commentator said that specification of minimum crew is an operational item that may vary with the type of operation, e.g., for compensation or hire which by law must be conducted in accordance with the highest standards. He concluded that rules specifying the number of crew members for specific operations should be in the operating regulations. The FAA agrees that certain rules concerning the number of crew members properly belong in the operating rules, and this is done, for example, in Subpart M of Part 121. However, under current § 23.1523, the minimum crew is established for VFR only, without requiring consideration of the additional crew duties that arise when IFR operations are authorized. These duties may be imposed by the design and operating characteristics of the aircraft and by its installed equipment. The FAA believes that they must therefore be evaluated during the type-certification process. The proposal to revise § 23.1523 is adopted without substantive change.

Proposal 6-25. One commentator objected to proposed § 23.1541 concerning placards in airplanes of 6,000 pounds or less maximum weight for reasons stated in his comments on Proposal 6-3 concerning Flight Manuals. For a discussion of these comments, see Proposal 6-3. Proposed § 23.1541 is adopted without substantive change.

Proposal 6-26. One commentator objected to proposed § 23.1559 concerning placards in airplanes of 6,000 pounds or less maximum weight for reasons stated in his comments on Proposal 6-3 concerning Flight Manuals. For a discussion of those comments, see Proposal 6-3. Proposed § 23.1559 is adopted without substantive change.

Proposal 6-27. Proposed § 23.1567(b)(2) would require that utility category airplanes that do not meet the spin requirements for acrobatic category airplanes have a placard in clear view of the pilot stating "Spins prohibited." One commentator said that the proposal is redundant and would add to the already confusing proliferation of cockpit placards. The FAA does not agree since the proposal would prevent any possible confusion as to whether a particular utility category airplane has been approved for spins. The proposal is adopted without substantive change.

Proposals 6-28, 2-39, 2-43, and 2-45. Proposed § 23.1581(a) is revised in accordance with the discussion of the proposal to amend § 25.1581 (Proposal 6-55). For another comment related to Proposal 6-28, see Proposal 6-3.

Disposition of Proposal 2-39 to add a new § 23.1353(f) (Notice 75-10) was deferred so that it could be considered in connection with Proposal 6-28. For comments related to proposed § 23.1353(f) and for an explanation of the revision to proposed § 23.1353(f), see the discussion of Proposal 2-87 under Proposal 6-57. Disposition of Proposal 2-45 to revise § 23.1581(b) and to add a new § 23.1581(d) (Notice 75-10) was deferred so that it could be considered in connection with Proposal 6-28.

One commentator, who agreed in general with proposed § 23.1581(b), recommended several clarifications. He indicated that the title "Pilot's Operating Handbook" should be allowed as an alternative to "Airplane Flight Manual." The FAA has no objection to the title "Pilot's Operating Handbook" if the title page also includes a statement indicating that the document is an FAA-required Airplane or Rotorcraft Flight Manual.

The commentator also indicated that the FAA should delete any requirement for individual page approval for operating limitations in Handbooks that meet a specification acceptable to the Administrator. Proposed § 23.1581(b)(1) would require approval of each page containing the prescribed operating limitations whereas current § 23.1581(b) requires that each part of the Airplane Flight Manual containing information presented in §§ 23.1583 through 23.1589 be approved.

The intent of proposed §§ 23.1581(b)(1) and (b)(2) was to require that the presentation of operating limitations be approved by the FAA and be clearly identified as such while at the same time providing an option for the presentation of the other required information. This option would have provided that each page containing the information prescribed in §§ 23.1585 through 23.1589 had to be determined in accordance with the applicable requirements of this part and had to be approved or the information presented in its entirety in a manner acceptable to the Administrator.

In light of the comments received and after further review, the FAA believes that this intent will be accomplished in a simpler manner, and will be more consistent with Parts 25, 27, and 29 flight manual requirements, by retaining the current requirements and providing an alternative to the current requirements in a separate paragraph which provides that each part containing operating limitations must be approved and limited to such information, and the information prescribed in §§ 23.1585 through 23.1589 must be determined in accordance with the applicable requirements of this part and presented in a manner acceptable to the Administrator. Proposed §§ 23.1581(b)(1) and (b)(2) are revised to reflect the changes discussed above.

The references in proposed §§ 23.1581(b)(1) and (b)(2) to the information prescribed in §§ 23.1581(c) (paragraph (a)(2) as adopted) have been deleted to be consistent with the flight manual requirements of Parts 25, 27, and 29.

One commentator objected to Proposal 2-45 on the grounds that procedures, performance data, and loading information for any airplane certificated under Part 23 would not have to be approved by the FAA. This comment evidently refers to proposed § 23.1581(b)(2)(i) (which is incorporated into paragraph (b)(2) as adopted), under which the information prescribed in §§ 23.1585 through 23.1589 would not be identified as FAA-approved, if this information in its entirety is presented in a manner acceptable to the Administrator. The FAA does not agree with the comment. Under the proposal, the information would have to be determined in accordance with the applicable requirements of Part 23. In finding that a manual is acceptable, the FAA would review the manual to determine that the required information is complete and accurate. The manual would also be reviewed to ensure that any additional information provided by the applicant is not in conflict with required information or contrary to the applicable airworthiness requirements. The FAA believes that § 23.1581(b)(2) will provide an adequate method of review of the information prescribed in §§ 23.1585 through 23.1589.

The proposals to amend § 23.1581 are adopted with the revisions discussed above.

Disposition of Proposal 2-43 to amend § 23.1555 (Notice 75-10) was deferred so that it could be considered in connection with Proposal 6-28. No unfavorable comments were received on Proposal 2-43, however, proposed § 23.1555(c)(3) is revised by deleting the words "and in the Airplane Flight Manual" in view of the requirements of §§ 23.1581 and 23.1587(a)(2), as adopted.

Proposal 6-29. For comments related to the proposal to revise § 23.1583(b), see Proposal 6-23.

Proposal 6-30. One commentator objected to the application of proposed § 23.1585, concerning operating procedures, to airplanes of 6,000 pounds or less maximum weight for reasons stated in his comments on Proposal 6-3 concerning Flight Manuals. For a discussion of these comments, see Proposal 6-3.

The proposal to amend § 23.1585 is adopted without substantive change.

[For discussion concerning new § 23.1585(e), see Proposals 6-57 and 2-87.]

Proposals 6-31 and 2-46. One commentator objected to the application of proposed § 23.1587, concerning performance information, to airplanes of 6,000 pounds or less maximum weight for reasons stated in his comments on Proposal 6-3 concerning Flight Manuals. For a discussion of these comments, see Proposal 6-3.

Another commentator stated, in response to proposed § 23.1587(a)(7), which would require information on the steady rate or gradient of climb, that if gradient data are presented, conversion charts should be included, and that ideally each determination should be available; however, he concluded that the option of one or the other should be deleted and a definite requirement adopted. The commentator misinterpreted the proposed requirement. Section 23.65(c), as adopted by this amendment, requires the determination of a gradient of climb for turbine engine powered airplanes. Proposed § 23.1587(a)(7) is worded so as to take into account the requirement of § 23.65(c), not to provide an option for the applicant, i.e., whether gradient of climb or rate of climb is furnished under § 23.1587(a)(7) will be determined by the applicable requirement of §§ 23.65 and 23.77.

Section 23.1587 is adopted as proposed, except that a new § 23.1587(a)(9) has been added to include information on the maximum ambient temperature at which compliance with the cooling requirements is shown for reciprocating engines. This addition is explained in the discussion of the comments on Proposal 6-23.

Disposition of Proposal 2-46 (Notice 75-10), which proposed to delete the second sentence of present § 23.1587(a)(2), was deferred so it could be considered with Proposal 6-31. No unfavorable comments were received on Proposal 2-46. Proposal 2-46 was reproposed in Proposal 6-31, and is adopted without substantive change with the adoption of Proposal 6-31.

Proposal 6-32. Proposed new § 25.21(f) would require that when surface winds must be considered, the wind velocity must be measured at or corrected to a height of 10 meters above the surface, because the National Weather Service is standardizing on a height of 10 meters for reporting winds at airports. One commentator said that since the purpose of the proposal is standardization of Airplane Flight Manual performance information with respect to reported winds for takeoff or landing in service operations, the requirement should be placed in the flight manual requirements under § 25.1587(c)(1)(i) instead of in § 25.21. The FAA agrees that this is one purpose of the proposal but there are flight requirements other than those concerning performance information that require consideration of surface winds. Therefore, the FAA believes that it is more appropriate to include the proposed requirement in § 25.21. However, proposed § 25.21(f) is revised to clarify its applicability.

The proposed change to § 25.21(d), which deals with tolerances for variables in flight testing, would delete the requirement that the tolerance on wind during takeoff and landing tests must be based on the wind measured at a height of 6 feet above the runway. The commentator said that performance analysis is usually based on winds at the height of the mean aerodynamic center of the airplane above the runway surface, and that the data in the Airplane Flight Manual is then corrected to the currently used height of 50 feet. The commentator recommended that this procedure be continued, except that the wind velocities in the Flight Manual should be based on a height of 10 meters instead of 50 feet. The FAA believes that the proposed deletion of the 6-foot height from § 25.21(d), together with proposed § 25.21(f), as revised, would allow continued use of the procedure recommended by the applicant.

The commentator also suggested that the correction chart in Civil Aeronautics Manual 4b Appendix A, Figure 2, be considered for inclusion in Part 25. The FAA does not believe that it is necessary to include this information in the rules.

The proposal to amend § 25.21 is adopted with the revisions discussed above.

Proposal 6-33. For comments related to the proposal to amend § 25.29, see Proposal 6-5.

Proposal 6-34. Several commentators objected to the method of computing V_1 (takeoff decision speed) in proposed § 25.107(a) on the grounds that—(1) the speed increment between V_{EF} (engine failure speed) and V_1 should not be determined with all engines operating because the accelerate-stop distance determined under proposed § 25.109(a) would then be unnecessarily large for the critical engine failure condition (especially for twin-engine airplanes); and (2) placing the 2.0-second time delay between V_{EF} and V_1 in proposed § 25.107(a)(2)(ii) does not adequately provide for these instances in which the pilot may have to analyze and react to an event that occurs immediately before reaching V_1.

It was recommended that proposed § 25.107(a) be revised so that V_1 is determined by adding to V_{EF} the speed gained with the critical engine inoperative during the time interval between the instant at which the critical engine is failed and the instant at which the test pilot recognizes and reacts to the engine failure, as indicated by the pilot's application of the first retarding means during accelerate-stop tests (the 2.0-second minimum time delay that was proposed to be included between V_{EF} and V_1 would be deleted). It was further recommended that proposed § 25.109(a) be revised so that a 2.0-second time delay following V_1 is incorporated into the determination of accelerate-stop distances, as follows: (1) for the engine failure case, the acceleration of the airplane from V_{EF} would be with the critical engine inoperative and would continue for 2.0 seconds after reaching V_1; and (2) for the other event case, the acceleration of the airplans would be with all engines operating and would continue for 2.0 seconds after reaching V_1.

After considering all of the comments on these proposals and after further review, the FAA agrees with these comments and the recommendations. The FAA believes that the recommended revisions would provide for events other than engine failure, even though the speed increment between V_{EF} and V_1 would be determined with the critical engine inoperative instead of all engines operating, because the accelerate-stop distance for the other event case would be determined with all engines operating from the start of takeoff until 2.0 seconds after V_1 is reached. Further, the FAA believes that deleting the 2.0 second minimum time delay from the determination of V_1 and inserting a 2.0-second delay after V_1 in the determination of the accelerate-stop distance would be more appropriate for most rejected takeoff situations, since stopping requires a positive decision and action by the pilot. Proposed §§ 25.107(a) and 25.109(a) are revised accordingly.

Several commentators objected to the 2.0-second (minimum) time delay used in computing V_1 under proposed § 25.107(a)(2)(ii) on the grounds that it would increase the required take-off runway lengths, particularly in the engine failure case, and that such increases are not justified. One commentator recommended that the time delay be reduced to 1.0 second. The revisions discussed above significantly reduce the effect of the 2.0-second time delay on the required accelerate-stop distance in the engine failure case. Under § 25.107(a) as proposed, the airplane would be accelerated to a V_1 speed equal to V_{EF} (engine failure speed) plus the speed gained with all engines operating during a total time interval of about 3 seconds (i.e., during the time required for the test pilot to recognize and react to an engine failure in accelerate-stop tests, plus a 2.0-second time delay for service operations). Under proposed § 25.109(a), the accelerate-stop distance for the engine failure case would be determined by accelerating the airplane from V_{EF} to the V_1 speed determined under proposed § 25.107(a), but with the critical engine inoperative instead of with all engines operating. As pointed out by one of the commentators, the total time interval between engine failure and application of the first retarding means could then become about 6 seconds for a twin-engine airplane in the engine failure case, and the distance traversed during the additional 3 seconds (beyond the time interval prescribed in § 25.107(a) would be included in the accelerate-stop distance. However, under the revisions incorporated in §§ 25.107(a) and 25.109(a) as adopted, the revised V_1 speed is equal to V_{EF} plus the speed gained with the critical engine inoperative during the test pilot's recognition-reaction time interval with no further time delay. The accelerate-stop distance for the engine failure case is then determined by accelerating the airplane with one engine inoperative from V_{EF} to the revised V_1 speed and then for an additional 2.0 seconds, before the first retarding means is applied. Under these revisions, a 2.0-second allowance for time delays in service operation is retained, but the total time interval between V_{EF} and application of the first retarding means in the engine failure case would be significantly reduced (for example the reduction could be from about 6 seconds to about 3 seconds for a twin engine airplane). The accelerate-stop distance for the engine failure case would be reduced accordingly. The FAA does not believe that any further revision is warranted because the 2.0-second delay (incorporated into § 25.109 as adopted rather than § 25.107) is necessary to allow for a surprise element and other operational factors not covered in accelerate-stop tests.

One commentator proposed that V_1 speeds be established as recognition speeds for both engine failure and other event cases. However, it is not clear how a recognition time for "other events" would be determined since there is a large variety of possible events that could lead to a rejected takeoff.

Another commentator, in addition to suggesting changes similar to those already made as discussed above, recommended that V_1 be established as a failure recognition speed which would be determined by adding to the speed at which the initial failure is assumed to occur, the time between the failure and the pilot's recognition of the failure (assumed to be 2.0 seconds before his reaction to the failure), and the time not less than 2.0 seconds, to allow for time delays in service under reasonably unfavorable operating conditions. The FAA does not agree that there should be a 2.0-second minimum delay, regardless of the pilot's actual reaction time, in determining V_1 under § 25.107(a), because proposed § 25.109(a) as revised will require that the accelerate-stop distance computations include acceleration of the airplane for 2.0 seconds after V_1 is reached.

This commentator further proposed that closing of the throttles be specified in proposed § 25.109 as the first action to be taken in stopping the airplane, with subsequent actions at intervals of not less than one second. Current § 25.101(h) already requires that the procedures used in determining the accelerate-stop distance must be able to be consistently executed in service by crews of average skill, and must include allowance for any time delays in the execution of the procedures that may be reasonably expected in service. The order in which the retarding devices are applied and the subsequent time delays will be established during type certification under the general provisions of § 25.101(h).

One commentator objected to the requirement in proposed § 25.107(a) that V_{EF} may not be less than V_{MCG} (minimum control speed on the ground) determined under (proposed) § 25.149(e). The commentator stated that it should only be required that V_1 not be less than V_{MCG} because if an engine failure is recognized between V_{EF} and V_1 the takeoff should be aborted. However, under proposed §§ 25.107(a) and 25.109(a), as revised V_1 will be placed at the speed at which the test pilot recognizes and reacts to an engine failure during accelerate-stop tests and the 2.0-second time delay will be inserted after V_1 instead of between V_{EF} and V_1 as proposed. This revision allows V_1 to be very close to V_{EF}. Therefore, the effect on takeoff and accelerate-stop distances of requiring that V_{EF} not be less than V_{MCG} has been significantly reduced because of the deletion of the minimum 2.0-second delay between V_{EF} and V_1. In addition, the FAA believes that V_{EF} should not be less than V_{MCG} so that there will be at least a small margin between V_{MCG} and V_1 to ensure controllability of the airplane at V_1.

One commentator recommended that the proposals containing V_1 and accelerate-stop distances be made retroactive to existing transport category airplanes one year after the date of their adoption. Current § 25.101(h) already provides that the procedures used in determining accelerate-stop distances include allowance for time delays reasonably expected in service. The purpose of the present proposals is to clarify and standardize the method of including an appropriate time delay in the accelerate-stop performance determination for airplanes type certificated in the future.

In regard to proposal 6-2, which would change the definition of V_1 in § 1.2 from "critical engine failure speed" to "takeoff decision speed," one commentator considered the proposed definition to be inadequate because "decision" is an undefined quantity. The commentator recommended that the proposal be revised to state that V_1 means the speed at which the flight crew has recognized an engine failure or other event and takes action either to reject or continue the takeoff. The significance of V_1 with respect to accelerate-stop distance, takeoff distance, and the related operating procedures is explained in the Airplane Flight Manual and the FAA believes it is too complex to be completely described in a brief definition in § 1.2. Accordingly, the proposed amendment of § 1.2 is adopted without substantive change.

The proposals to revise §§ 25.107(a) and 25.109(a) are adopted with the revisions discussed above.

Proposal 6–35. One commentator stated that if the intent of proposed §§ 25.107(d) and (e)(1)(iv) with respect to the engine-out V_{MU} is to ensure controllability, the V_R–5 tests required by § 25.107(e)(3) should be expanded to require the test over the full range of certification conditions and all references to one-engine-inoperative V_{MU} should be deleted from §§ 25.107(d) and (e). The FAA does not agree with this recommendation because it would ignore the performance aspects (thrust-to-weight ratio) of the one-engine-inoperative V_{MU} demonstration.

Another commentator stated that flight test experience has shown that trim and control drag is accounted for with the thrust/weight ratio corresponding to the one-engine-inoperative condition used in the test, and that actual engine-out V_{MU} tests result in the same V_{MU} as tests conducted at the simulated engine-out thrust-to-weight ratio. The FAA agrees, and the last sentence of proposed § 25.107(e)(iv) is deleted. The proposal to amend § 25.107 is adopted with the revision discussed above.

Proposal 6–36 . For comments related to proposed § 25.109(a), see Proposal 6–34.

Proposal 6–37. One commentator agreed with the proposed change to § 25.111(a)(2), which would delete the reference to V_1 and substitute V_{EF} in its place to make § 25.111(a) consistent with proposed § 25.107(a) (Proposal 6–34). However, this commentator did not agree with making the same change to § 25.111(a)(3), and said that the present reference to V_1 in that paragraph is correct for the new definition of V_1 (i.e., as defined in proposed §§ 1.2 and 25.107(a)). The FAA does not agree with the comment on proposed § 25.111(a)(3) because it would leave a gap in the requirements for the speed range between V_{EF} and V_1.

Accordingly, the proposal to amend §§ 25.111(a)(2) and (a)(3) is adopted without substantive change.

Proposal 6–38. Proposed § 25.121(e) would require the determination of the vertical distance required to make a transition from a 3-degree descent path in the landing configuration with the critical engine inoperative to a stabilized climb condition. Several commentators stated that the vertical distance determined in this manner should not be considered a minimum decision height for approaches. The FAA agrees, since the establishment of decision height requires consideration of many operational factors. Some commentators stated that the landing configuration in the proposal is not appropriate for one-engine-inoperative approaches. One commentator recommended that the horizontal as well as the vertical distance for transition to approach climb be determined, and referred to the work of the ICAO Obstacle Clearance Panel on this subject. Another commentator recommended that the required determination take into account the minimum control speed, V_{MC}. In light of the comments received, and after further review, the FAA believes that proposal 6–38 should be withdrawn.

Proposal 6–39. Several commentators objected to the proposal to amend § 25.123(a) on the ground that current § 25.123(a) is conservative and has the advantage of greater simplicity. The FAA agrees and the proposal to amend § 25.123(a) is therefore withdrawn.

Proposal 6–40. One commentator recommended that proposed § 25.143(b) be withdrawn and that current § 25.143(b) be retained on the ground that there are areas within the flight envelope from takeoff to landing where the failure of a second engine cannot be handled smoothly and safely. The commentator also stated that the proposed amendment is vague and could produce confusion with respect to time between failures, and that it could be interpreted to require a combination of double engine failure and configuration changes. The FAA agrees that the proposed rule requires some clarification, but does not believe that the current § 25.143(b) should be retained. With respect to failure of a second engine on airplanes with three or more engines, the FAA believes that failure of a second engine can be reasonably expected in the enroute, approach, and landing stages of flight after failure of one engine earlier in the flight.

Therefore, proposed § 25.143(b) is revised to require consideration of the sudden failure of the second critical engine when the airplane is in a trimmed condition with one engine inoperative in the enroute, approach, and landing configurations. This revision also clarifies the requirement with respect to time between engine failures by providing that the airplane is in a trimmed condition with one engine inoperative when the second engine is failed. In regard to combination of engine failure and configuration changes, it should be noted that the introductory sentence of proposed § 25.143(b) refers to "probable operating conditions," and that some change of configuration may be desirable after engine failure, e.g., retracting the landing gear for a go-around after engine failure in the landing configuration.

Another commentator considered the proposed configuration change requirement to be too general and vague and suggested that the proposed requirement contain certain specific criteria. The commentator also recommended that interpretative material be included in the rule or in the associated Flight Test Guide. The FAA does not agree. The FAA believes that the wording of the proposed rule is clear and would accomplish the intended purpose.

The proposal to amend § 25.143(b) is adopted with the revision discussed above.

No unfavorable comments were received on the proposal to amend § 25.143(c), which would reduce the maximum allowable rudder force for temporary application in meeting the controllability requirements, from 180 pounds to 150 pounds. Accordingly, the proposal is adopted without substantive change. For consistency with § 25.143(c), as adopted, and since flight test experience has shown that 180 pounds may make control difficult for some pilots under some flight conditions, § 25.147(a) is amended by deleting the reference to "180 pounds" and inserting in its place "150 pounds".

Proposal 6-41. One commentator recommended deletion of proposed § 25.149(a), which would require that the method used to simulate critical engine failure must represent the modes of powerplant failure expected in service. The FAA does not agree. This provision is necessary to ensure that the most adverse condition with respect to controllability is considered. To clarify this intent, § 25.149(a) is revised to require consideration of the most critical mode of powerplant failure with respect to controllability expected in service. This commentator objected specifically to dynamic engine cut demonstrations because of the hazards involved. The FAA believes that dynamic effects should be considered during type certification, since they might occur in service operations.

Upon further review, the FAA believes that specific guidance as to the setting of the propeller on propeller-driven airplanes is necessary with regard to proposed § 25.149(c). Current § 25.149(b)(8) specifies the setting of the propeller for reciprocating engine-powered airplanes. Current § 25.149(c)(5) specifies that for turbine engine-powered airplanes, the airplane must be ". . . in the most critical takeoff configuration existing along the flight path . . ." and has been administered to require that the setting of the propeller of turbine engine-powered, propeller-driven airplanes be the same as that specified in current § 25.149(b)(8). Accordingly, current § 25.149(b)(8) is retained and redesignated § 25.149(c)(7), to be applicable to all propeller-driven airplanes.

One commentator stated that the pilot should be provided with information regarding the effects of bank angle on V_{MC}. The FAA does not have enough information at this time to justify the suggested requirement.

Proposed § 25.149(e) would require the determination of a minimum control speed on the ground, V_{MCG}, for use in establishing takeoff speeds under proposed § 25.107 (see Proposal 6-34). One commentator recommended that the second sentence of proposed § 25.149(e) be revised to read "During this demonstration, the permissible lateral deviation of the path of the airplane would be limited to 30 feet." He said that the revision would eliminate the possibility of misinterpretation. The FAA believes that the language of the proposal is clear; however, it may be too restrictive in requiring the ground track to be parallel to or converging toward the centerline of the runway when the airplane is rotated for takeoff, and thereby unnecessarily delay rotation in determining takeoff performance under §§ 25.107(e) and 25.111. Section 25.149(e) is therefore revised to state that the airplane's path, from the point at which the critical engine is made inoperative to the point at which recovery to a direction parallel to the runway centerline is completed, may not deviate more than 30 feet laterally from the centerline. The adopted rule would allow the airplane to be rotated for takeoff before recovery to a direction parallel to the runway centerline is completed; however, it should be noted that it requires that V_{MCG} must be determined to enable the takeoff to be safely continued using normal piloting skill. The commentator also recommended that proposed §§ 25.149(e)(3) and (e)(5) be deleted because flight tests have proven that gross weight and center of gravity have no effect on V_{MCG}. The FAA does not agree. The airplane's acceleration varies with its weight, and this may affect directional control and lateral deviation. The center-of-gravity location may also affect directional stability and control on the ground.

One commentator stated that proposed § 25.149(e) would allow a lateral deviation of 30 feet during the determination of V_{MCG}, whereas the current FAA Flight Test Handbook recommends 25 feet and the Air Force requires 25 feet. The commentator recommended that 25 feet be specified in the adopted rule. The FAA believes that the 30-foot deviation limit will assist in international standardization in this area. In addition it should be noted that § 25.107(a)(1) as adopted (see discussion of Proposal 6–34) requires V_{EF} to be not less than V_{MCG} and V_1 to be greater than V_{EF}, thus providing a small controllability margin at V_1.

Several commentators recommended that the proposal be revised to allow the use of nose wheel steering in the determination of V_{MCG} under § 25.149(e), if control is through the rudder pedals and the demonstration is made on a wet runway. The FAA does not agree. The effectiveness of nose wheel steering depends to a large degree on runway friction characteristics and the load on the nose wheel. Certification tests on a wet runway would not cover the more extreme slippery runway conditions or all possible variations in takeoff conditions and techniques likely to occur in service. The FAA therefore believes that V_{MCG} should be determined without the use of nose wheel steering, as stated in proposed § 25.149(e).

In regard to the airplane configuration used in determining V_{MCG}, one commentator recommended that proposed § 25.149(e)(1) be revised to specify each takeoff configuration instead of the most critical takeoff configuration, to allow a separate V_{MCG} for different flap settings. The FAA agrees that an applicant should be allowed to determine a separate V_{MCG} for different takeoff configurations but believes that the applicant should also have the option of determining a V_{MCG} value for only the most critical takeoff configuration. Proposed § 25.149(e)(1) is revised accordingly.

Proposed § 25.149(e)(2) would require that V_{MCG} be determined with maximum permissible takeoff power or thrust on the operating engines; however, the word "permissible," in relation to power or thrust, is not defined or used elsewhere in the performance and flight characteristics requirements. For consistency with §§ 25.101(c) and 25.149(c)(1), the word "permissible" is replaced by "available" in § 25.149(e)(2) as adopted. It should be noted that § 25.101(c) refers to the propulsive thrust available under the particular flight condition and thus provides for any difference between the takeoff thrust set during takeoff and the thrust available in flight for a go-around.

Proposed §§ 25.149(f), (g), and (h) would require the determination of two new minimum control speeds, V_{MCL} and V_{MCL-2}, associated with an engine failure during landing approaches that are initiated with all engines operating and with one engine inoperative, respectively. One commentator said that these proposals are inconsistent with the V_{MCL} definitions being considered in the development of wet runway landing performance rules. The commentator recommended that these proposals be deleted until an acceptable rational landing rule is established. Another commentator stated that V_{MCL} and V_{MCL-2} would serve no useful purpose and may confuse flight crews. The FAA does not agree with these comments. These proposals are intended to cover the controllability aspects of an engine failure during landing approach. Proposed § 25.149(f) as revised is intended to determine a minimum control speed for the situation where an engine fails after power or thrust has been increased to make a go-around from an approach with all engines operating. For airplanes with three or more engines, proposed §§ 25.149 (g) and (h) as revised are intended to determine a minimum speed for maintaining safe control during the power or thrust changes that are likely to be made following the failure of a second engine during an approach initiated with one engine inoperative. The FAA believes that these proposals, with revisions discussed, should be adopted at this time to provide information for use in pilot training and service operations.

One commentator noted that proposed §§ 25.149(f)(5), (g)(5), and (h)(2) specify "maximum permissible power" in the determination of V_{MCL} and V_{MCL-2}. The commentator recommended that this be changed to "takeoff or maximum permissible power" as used in present § 25.149. Another commentator said that it is not clear whether "maximum permissible thrust" in proposed §§ 25.149(f), (g), and (h) means maximum takeoff (or contingency) thrust, or whether a lower thrust can be scheduled. This commentator also stated that takeoff (or contingency) thrust would represent an increase in severity with respect to both the British Civil Air Regulations and present § 25.149(d), and that the thrust to be associated with recovering control following a sudden engine failure in §§ 25.149(f) and (g) should be the power required for a 3-degree approach, and the thrust range to be associated with maintaining straight flight thereafter should be from minimum power to power for level flight or maximum power, whichever occurs first.

As explained in the preceding discussion of § 25.149(e)(2), current § 25.149(c)(1) uses the words "maximum available takeoff power or thrust". The FAA believes that, for V_{MCL}, the power or thrust condition at the time of engine failure should be the thrust associated with a go-around and therefore believes that maximum available takeoff power or thrust should be prescribed in § 25.149(f) since the approach climb requirements in § 25.121(d) allow use of available takeoff power or thrust. Proposed § 25.149(f) is revised accordingly.

However, since there are no performance requirements for a go-around with two engines inoperative, the FAA believes that the initial power condition at the time of failure of the second engine in § 25.149(g) for V_{MCL-2} should be that for a 3-degree approach with one engine inoperative. This is one of the initial power conditions prescribed in proposed § 25.149(h). In regard to the maximum power or thrust to be applied after the second engine is made inoperative, the FAA believes that the value of V_{MCL-2} to be furnished as information to the pilot should be based on the power or thrust that provides the maximum performance capability of the airplane without exceeding the powerplant limitations, i.e., maximum available takeoff power or thrust at the upper end of the range, and minimum available power or thrust at the lower end of the range. Proposed § 25.149(g) is revised accordingly.

Since V_{MCL} will be determined with maximum available takeoff power, proposed § 25.149(h) is revised so that the requirement of changing the power or the operating engines after failure of the critical engine only applies to V_{MCL-2}.

One commentator said that the critical weight for V_{MCL} can be the lowest weight, when a 5-degree bank angle is used, and he therefore recommended that proposed §§ 25.149(f)(4) and (g)(4) be revised to specify the most unfavorable weight in the range of landing weights, instead of the maximum sea level landing weight (or any lesser weight necessary to show V_{MCL}). The FAA agrees that light weight may be critical for V_{MCL} or V_{MCL-2} but does not believe that the recommended wording change is necessary. The proposal is consistent with current § 25.149(c)(4), and light weight conditions are considered under the current rule.

One commentator stated that the proposal requires determination of V_{MCL} and V_{MCL-2} but does not appear to require that this information be made available to flight crews or that it be used in determining the approach speed. The commentator recommended that the proposal be changed to require that V_{MCL} and V_{MCL-2} be included in the Airplane Flight Manual and also that the landing performance requirements in § 25.125 be amended to take account of V_{MCL}. The FAA does not have sufficient information to justify changing the landing performance requirements in the manner recommended by the commentator. However, information regarding V_{MCL} and V_{MCL-2} would be required to be furnished in the Airplane Flight Manual pursuant to the provisions of § 25.1585 (a)(1).

For a comment related to the clause "either with zero yaw or with an angle of bank of not more than 5 degrees", which is contained in proposed §§ 25.149(e), 25.149(f), and 25.149(g), see Proposal 6–13.

The proposal to amend § 25.149 is adopted with the revisions discussed above.

Proposal 6–42. One commentator stated that the exception in proposed § 25.177(b)(2) for the speed range from V_{MO}/M_{MO} to V_{FC}/M_{FC} should also be applicable to the speed range from 1.2 V_{S1} to V_{MO}/M_{MO}. The FAA does not agree. V_{MO}/M_{MO} is the maximum operating limit speed. Gradual divergence that is easily recognizable and controllable by the pilot is allowed in the speed range above V_{MO}/M_{MO} because it is expected that operation at speeds above V_{MO}/M_{MO} will occur only for brief periods and that flight control demands will in general be limited to the restoration of flight at speeds below V_{MO}/M_{MO}.

Accordingly, the proposal to revise § 25.177(b) is adopted as proposed except that a provision for maximum flap extended speed and maximum landing gear extended speed has been added for clarification and consistency with the present rule.

Proposal 6–43. Proposed § 25.181(b) would require that combined lateral-directional ("Dutch roll") oscillations be positively damped, i.e., diminish after a disturbance, but it does not specify the degree of damping. One commentator recommended that the proposal be revised to state that lateral-directional oscillations should be damped but that neutral damping or mild divergence would be acceptable if it is easily controllable by the pilot. The commentator said the proposal is unnecessarily restrictive following the failure of a stability augmentation device, since the device must be designed to meet § 25.21(e), and that the damping required should be related to the frequency and amplitude of the oscillation, the pilot tasks, and environmental effects. The commentator also said that, if unsatisfactory damping following a failure is confined to an avoidable flight area or configuration and is controllable to return the aircraft to a satisfactory condition for safe flight, the lack of appreciable positive damping may be acceptable. The FAA does not agree with this recommendation. Current § 25.181 requires any short period oscillation to be heavily damped, and the proposal would require that combined lateral-directional oscillations be positively damped instead of heavily damped. The change recommended by the commentator would increase the pilot's tasks and could result in an unsafe situation when operating in rough air. Section 25.672(c) already allows degradation of stability and other flight characteristics after any single failure in a stability augmentation system if the airplane is safely controllable and the resulting stability characteristics allow continued safe flight and landing.

Another commentator recommended that the proposal should be changed to raise the lower limit of the speed range for positive stability from the stalling speed to 1.2 V_{S1}. The proposal is the same as the current rule with respect to the lower speed limit of the speed range for positive stability and the FAA does not have sufficient information at the present time to justify raising the lower speed limit to 1.2 V_{S1}.

The proposal to revise § 25.181 is adopted without substantive change.

Proposal 6–44. One commentator recommended that the proposal to amend § 25.201 and the proposal to amend § 25.207 (Proposal 6–45) be withdrawn in light of current FAA studies on landing distances which may result in a new stall requirement. The FAA does not agree with this recommendation because the proposals for §§ 25.201 and 25.207 deal with stall demonstration and stall warning, and current studies for the landing distance rules do not include changes to §§ 25.201 and 25.207.

Another commentator stated that many modern airplanes are accepted as having correct stalling characteristics even though these occur before reaching the angle of attack for maximum lift, and suggested that the phrase "at an angle of attack measurably greater than that for maximum lift" be deleted from proposed § 25.201(d)(1). Proposed § 25.201(d)(2) sets forth an exception to the requirements of proposed § 25.201 (d)(1) (this would be a relaxation of the requirement in current § 25.201(c)(2) with respect to those instances in which the airplane may be considered to be stalled). The FAA does not believe any further relaxation would be justified.

One commentator expressed concern that proposed § 25.201 might result in unwarranted increases in operational speeds and runway length requirements; however, no explanation of this comment was provided. Some operating speeds are affected by stalling speeds which are determined under §§ 25.103, 25.203, and 25.201. Proposed § 25.201 (d)(2) provides that for an airplane demonstrating an unmistakable inherent aerodynamic warning in a particular configuration of a magnitude and severity that is a strong and effective deterrent to further speed reduction, the airplane may be considered stalled when it reaches the speed at which the effective deterrent is clearly manifested. (This exception is present in the current rule but is only applicable to those airplanes demonstrating the required degree of warning in all required configurations.) The FAA believes that it is necessary that an applicant be allowed to limit the stall demonstration to the speed where a strong and effective deterrent (such as severe buffeting) is clearly manifested because operation of the airplane at any lower airspeed may be hazardous. Therefore, the FAA believes that any increase in an operating airspeed because a stall demonstration was limited to the airspeed at which there exists an effective deterrent, as provided in proposed § 25.201(d)(2), is justified.

Accordingly, the proposal to amend § 25.201 is adopted as proposed, except that a nonsubstantive change is made to proposed § 25.201(d)(2) to clarify its intent. The proposal to amend § 25.207 is adopted without substantive change.

Proposal 6–45. For comments related to the proposal to amend § 25.207, see Proposal 6–44.

Proposal 6–46. Proposed § 25.233(a) would change the requirements concerning ground looping tendency in cross winds by substituting "25 knots" in place of "0.2 V_{S0}" for the prescribed wind velocity. Several commentators objected to the use of 25 knots for the required wind velocity, stating that the present requirement corresponds to about 20 knots for most airplanes, and that standardizing on a height of 10 meters above the surface for airport wind velocities (see Proposal 6–32 for § 25.21(f)) would also increase the required cross wind component (as compared with the present practice of correcting wind velocity to a height of 50 feet). The FAA agrees that 20 knots would be an appropriate minimum value for the cross wind component; however, this would be less severe than the present rule for airplanes with a stalling speed (V_{S0}) greater than 100 knots. Therefore, § 25.233(a) is revised to replace "0.2 V_S" with "20 knots or 0.2 V_{S0}, whichever is greater, except that the wind velocity need not exceed 25 knots".

One commentator suggested that the rule be written to allow the use of analysis to show acceptable ground handling characteristics for cross wind components greater than 20 knots. The FAA does not agree that analytic methods are reliable for this purpose. (See discussion of Proposal 6–47.)

Proposal 6–47. Proposed § 25.237(a)(1) would establish 25 knots as the minimum cross wind component for landplanes, to be demonstrated on dry runways. Several commentators objected to the use of 25 knots for the required minimum wind velocity. For reasons explained in the discussion of Proposal 6–46, proposed §§ 25.237(a) and (b) are revised, consistent with § 25.233 as adopted, by replacing "25 knots" with "20 knots or 0.2 V_{S0}, whichever is greater, except that it need not exceed 25 knots."

Proposed § 25.237(a)(2) would require that a safe cross wind component be established for wet runways, but would allow this to be determined by analysis in lieu of demonstration. Two commentators recommended that the proposal concerning wet runways be deleted, since there is no definition of "wet," and they considered the current rules for cross wind operation to be adequate for either wet or dry cases. Two other commentators doubted the validity of analytic methods for establishing a safe cross wind component for wet runways. In light of the comments received, and after further review, the FAA believes that proposed § 25.237(a)(2) is premature and it is withdrawn.

Proposal 6–48. Two commentators recommended that proposed § 25.251(e) be revised to prescribe an acceleration of ±0.1 g, instead of ±0.05 g, in defining the onset of buffet. One of the commentators stated that this change would ensure a level of buffet that would be distinguishable under turbulent air conditions. The commentator stated that contrary to the explanation in the notice, test pilots have signified the onset of buffet when the buffet level at a flight station was greater than ±0.1 g, and that defining buffet onset in § 25.251(e) as ±0.05 g would unnecessarily limit the altitude-payload capability of the airplane. After considering the comments received, and after further review, the FAA does not believe it has enough information at this time to specify an acceleration value for the onset of perceptible buffeting which would be applicable to all airplanes. Accordingly, the proposal is withdrawn.

Proposal 6–49. Proposed new § 25.255 would establish requirements for maneuvering and dive recovery characteristics with the airplane out of trim by the amount resulting from a three-second movement of the primary longitudinal trim system at its normal rate with no aerodynamic load, or the maximum mistrim that can be sustained by the autopilot while maintaining level flight in the high speed cruising condition, whichever is greater. One commentator said that the requirement would appear not to apply to a manual trim system, and that this should be made clear. The intent of the proposal is to provide a basic maneuvering stability and dive recovery requirement regardless of the type of trim system used in the airplane.

To make this intent clear, the first sentence of the lead-in of proposed § 25.255 is revised by inserting the parenthetic "(or an equivalent degree of trim for airplanes that do not have a power operated trim system)". In addition, current § 25.655(b) requires that if an adjustable stabilizer is used, it must have stops that will limit the range of travel to the maximum for which the airplane is shown to meet the trim requirements of § 25.161. Therefore, the first sentence of the lead-in of proposed § 25.255 is also revised by inserting an exception indicating that the trim movement need not exceed the range established by stops in the trim system, including those required by § 25.655(b) for adjustable stabilizers. It should be noted that the word "primary" in the first sentence of the lead-in of proposed § 25.255 is being deleted since its usage in this context is inappropriate. The same commentator also said that he does not understand the phrase relating to the autopilot, but believes there is a need for an analysis to show whether greater mistrim can result from autopilot or other system malfunction, or from normal autopilot functioning such as when flying on altitude hold through updrafts. The phrase in the proposal relating to autopilots is intended to provide for circumstances in which the trim system is actuated, either by a runaway or by the pilot, while the autopilot is engaged, and the autopilot is then disengaged when the degree of mistrim reaches the point where the autopilot can no longer hold level flight. The FAA believes that this is an appropriate test criterion. In addition, it should be noted that autopilot malfunctions are covered under § 25.1329.

One commentator recommended that the proposed wording "at its normal rate with no aerodynamic load" in the lead-in of proposed § 25.255 be replaced by "at the rate existing for the specified flight condition." The FAA agrees that where the trim system is designed to vary the rate of trim movement according to the flight condition (e.g., as a function of the dynamic pressure), this variation may be taken into account; however, the effects of aerodynamic loads on trim movement may vary in a complex manner, e.g., with center of gravity, airspeed, and system friction. As stated in the notice, the proposal is intended to simulate a typical out-of-trim condition. The FAA believes that the requirement should be specified so that the required trim change can be determined by a relatively simple and uniform procedure. Accordingly, § 25.255 as adopted is revised to specify a three-second movement of the trim system at the normal rate for the particular flight condition with no aerodynamic load.

One commentator recommended that § 25.255(a) be changed to read: "The slope of the stick force vs. g (curve) for load factors between $-1g$ and $+2.5g$ must be positive at speeds up to V_{FC}/M_{FC} or aural warning (speed) except that a 'flattening' of the stick force gradient or a reduction in stick force is permissible if it does not result in the tendency to overcontrol. Lesser acceleration values may be used at altitudes where buffet envelopes are established in accordance with § 25.251(e)." The FAA disagrees with the recommendation. Current § 25.253(b) already allows M_{FC} to be the same as the Mach number at which effective speed warning occurs for altitudes where Mach number is the limiting factor. At lower altitudes where airspeed is the limiting factor, V_{FC} under § 25.253(b) must be higher than the aural warning speed under § 25.1303(c)(1). Recoveries from severe upsets or evasive maneuvers are likely to be made in this altitude range at speeds above the aural warning speed. Threfore, the FAA believes that the proposed requirement should be met at speeds up to V_{FC}/M_{FC}. In addition, to minimize the possibility of over-control and over-stressing the airplane structure, the FAA believes that a reduction in stick force (negative slope of the stick force per g curve) should not be allowed at speeds up to V_{FC}/M_{FC}. However, it should be noted that flattening of the stick force gradient would be allowed under the proposal as long as the slope is positive.

The changes to proposed § 25.255(a) recommended by this commentator include deleting the proposed requirement for the speed range between V_{FC}/M_{FC} and V_{DF}/M_{DF} (the demonstrated flight dive speed). For this speed range, the proposal states that there may not be reversal of the primary longitudinal control force. Speeds above V_{FC}/M_{FC} have been reached during recovery from upsets in severe turbulence. The FAA believes that reversal of the direction of the control force (as shown on the stick force per g diagram) should not be allowed at speeds up to V_{DF}/M_{DF}, because force reversal on the primary control could be confusing to the pilots and contribute to hazardous over-control in severe turbulence.

Proposed § 25.255(a) provides that acceleration values less than those prescribed may be used at altitudes and speeds where buffet envelopes are established in accordance with § 25.251(e). One commentator objected to this provision and suggested that the proposal be revised to state that, at speeds up to V_{FC}/M_{FC}, the stick force curve must have a positive slope, and at speeds up to V_{DF}/M_{DF} there may not be a reversal of the primary longitudinal control force for normal acceleration values between -1 g and the lesser of 2.5 g and a normal acceleration corresponding, in the particular circumstances of weight, altitude, and air speed or Mach number, to buffeting or other phenomena, of such intensity as to be a strong deterrent to further application of primary longitudinal control force. The FAA does not believe that the buffeting criteria suggested by the commentator would be appropriate, since severe buffeting could mask the normal stick force gradient characteristics.

Another commentator suggested that the proposal be revised to state that "where buffet envelopes are established in accordance with § 25.251(e), the corresponding lesser acceleration values may be used." The FAA disagrees with the recommendation. The suggested wording would indicate that the requirement for positive maneuvering stability (stick force per g) is limited to the load factors within the buffet onset envelopes (i.e., perceptible buffeting) determined under § 25.251(e). However, § 25.251(e) also requires that probable inadvertent excursions beyond the boundaries of the buffet onset envelopes may not result in unsafe conditions. The FAA believes that positive maneuvering stability should be required for inadvertent excursions beyond the buffet onset boundaries, since a pilot is likely to exceed these boundaries in recovering from an upset.

Accordingly, § 25.255 is clarified by deleting the specific acceleration (g) values and exception clause in paragraph (a), and by setting forth a revised exception clause in a paragraph (e) which states that the accelerations need not exceed the maneuvering load factors associated with probable inadvertent excursions beyond the boundaries of the buffet onset envelopes determined under § 25.251(e). For consistency with the structural strength requirements, § 25.255(e) as adopted also states that the accelerations need not exceed the limit maneuvering load factors prescribed in §§ 25.333(b) and 25.337.

In addition, the other paragraphs of proposed § 25.255 have been restructured and redesignated for clarity. The second sentence of proposed § 25.255(d) would provide for the use of longitudinal trim to assist in producing the required 1.5 g for recovery. One commentator suggested that a clause be inserted to require that it be possible to produce at least 1.2 g without use of the longitudinal trim system and without exceeding a longitudinal control force of 125 lbs. The FAA believes that the recommended change is unnecessary because proposed § 25.255(d) already provides that longitudinal trim can only be used to assist in producing 1.5 g if it meets certain requirements.

Proposed § 25.255(d) requires that if the longitudinal trim is used to assist in the dive recovery, it must be shown that the trim can be actuated in the nose up direction with the primary surface (e.g., elevators) loaded to produce the least of the nose up control forces specified in paragraphs (d)(1), (d)(2), and (d)(3). One commentator recommended that proposed paragraph (d)(1) be deleted and that paragraph (d)(2) be changed to "125 pounds." The FAA does not agree. In an upset, the initial attempt at recovery is likely to be made with the primary pitch control, and on some airplane designs the airloads on the horizontal tail surfaces tend to prevent movement of the trim system at high speeds. The change recommended by the commentator assumes, in effect, that the pilots will actuate the trim in time to obtain recovery before they apply more than 125 pounds on the primary control. This may not be a valid assumption in extreme upset conditions.

One commentator stated that it is impracticable to demonstrate 1.5 g, and less than 1 g, at V_{DF}/M_{DF} in a flight test without exceeding V_{DF}/M_{DF}, and that some alleviation should be provided to cover this. Proposed § 25.255(d), which states that it must be possible from an overspeed condition at V_{DF}/M_{DF} to produce at least 1.5 g for recovery by applying not more than 125 pounds of control force, would only require that the test be started at V_{DF}/M_{DF}. With regard to accelerations less than 1 g, the commentator has apparently misinterpreted the requirement of proposed § 25.255(f). The intent of the requirement in proposed § 25.255(f) is that the entry speeds for flight test investigations at acceleration values less than 1 g should be limited to the extent necessary to accomplish a recovery without exceeding V_{DF}/M_{DF}. To clarify this intent, proposed § 25.255(f) is revised and incorporated into § 25.255(e).

Another commentator recommended certain changes in the arrangement of paragraphs in § 25.255 along with other changes already discussed above. The FAA believes, however, that the paragraphs of proposed § 25.255, as revised, are in the most appropriate order for clarity.

One commentator stated that proposed § 25.255 should be changed to be consistent with the manner in which the out-of-trim special condition has been applied in certification tests since 1965. The wording of the special conditions for various airplanes, and of related regulations §§ 25.251 and 25.253, has changed between 1965 and the present time. The proposal in the notice is based on the wording of recent special conditions.

Proposal 6–50. Proposed § 25.703 would require a takeoff warning system to warn the pilots during the initial portion of the takeoff roll if the airplane is in a configuration that would prevent successful completion of the takeoff. One commentator recommended that the proposed requirement for both aural and visual warnings be changed to require either an aural or visual warning. Another commentator questioned the desirability of a visual warning, particularly at night, citing the time that may be lost in searching for a visual warning. The FAA agrees with the latter comment. Accordingly, the requirement for an aural warning is retained and the requirement for a visual warning is withdrawn.

One commentator recommended that the words "including any of the following" (configurations) in proposed § 25.703(a) be changed to "consisting of the following" (configurations). The FAA does not agree since a particular airplane design may incorporate some other variable geometry device that would not allow a safe takeoff when in the wrong position.

The same commentator stated that proposed § 25.703(c), which would require that the means used to activate the system function properly throughout the ranges of takeoff weights, altitudes, and temperatures for which certification is requested, is superfluous and should be deleted. The FAA believes that this paragraph should be retained to clearly define the scope of the requirements.

This commentator also recommended deletion of proposed § 25.703(d) which would require that the system be designed to provide reliable sensing of an unsafe position of each critical aerodynamic surface. The commentator stated that such a system would be unworkable, over-sophisticated, and could degrade flight safety through numerous nuisance warnings. He pointed out that critical aerodynamic surfaces would include ailerons, rudder, and spoilers, and that "proper" position of such surfaces during takeoff would be affected by cross winds, engine failure, etc. The FAA agrees that the requirements in proposed § 25.703(d) could result in a warning system so complex that its effectiveness may be impaired. Proposed paragraph (d) is therefore withdrawn.

In regard to proposed § 25.703(b), one commentator recommended that consideration be given to a system cutoff at some significant airspeed, e.g., 100 knots. It was stated that any valid warning would probably have sounded by the time that speed is reached and the cutoff would preclude unwarranted aborts due to warning system malfunction at high speeds. Proposed § 25.703(b) would require the warning to continue until the configuration is changed to allow a safe takeoff, the takeoff roll is terminated, or the warning is manually deactivated by the pilot. The FAA agrees that a system cutoff at high speeds should be permitted, but believes that the cutoff should not be set below the V_1 speed, since the takeoff can be rejected within the established accelerate-stop distance from any speed up to V_1. Since the next speed above V_1 that can be sensed by a simple means is V_R (e.g., by nose gear switches), the FAA believes that deactivation of the takeoff warning system should be allowed when the airplane is rotated for takeoff. Proposed § 25.703 is revised accordingly.

With respect to the requirement in proposed § 25.703(b) that the warning must continue until the takeoff roll is terminated, the intention of the proposal was not to require that the warning must continue until the airplane is brought to a full stop, but that it must continue until action is taken by the pilot to terminate the takeoff roll, for example by closing all throttles. Proposed § 25.703(b) is revised accordingly.

Another commentator objected to the proposal, stating that the warning system would eliminate reliance on the checklist and induce more hazards than it is designed to eliminate. The FAA does not agree that the warning system would eliminate reliance on the checklist; instead it would serve as a back-up for the checklist, particularly in unusual situations, e.g., where the checklist is interrupted or the takeoff is delayed. The commentator stated that the additional aural warning system would add to the problem of cockpit confusion caused by the multitude of aural warning requirements. The FAA does not agree since the takeoff warning would occur during the initial portion of the takeoff roll and therefore should not be confused with flight over-speed warning, stall warning, or landing gear warning during approach. The commentator added that it is doubtful if a reliable, practical, safe system can be designed, much less for a cost that would approximate the possible benefits. The FAA does not agree since such systems have been developed and used on relatively complex airplanes. The warning systems can be simpler on airplanes having fewer or less critical variable geometry devices.

One commentator recommended that consideration be given to including unreleased brakes in the takeoff warning system in view of the serious consequences of failing to release brakes fully before takeoff. The FAA does not now have sufficient information to justify adopting the suggestion made by this commentator.

The proposed new § 25.703 is adopted with the revisions discussed above and a nonsubstantive revision for clarity.

Proposal 6–51. One commentator suggested the use of the word "suspended" rather that "silenced" in proposed § 25.729(e)(3). The FAA agrees with this suggestion, since it would result in consistency of wording between this section and proposed § 23.729(f)(1). Section 25.729(e)(3) is revised accordingly.

Proposal 6–52. For comments related to the proposal to revise § 25.1043(b), see Proposal 6–23.

Proposal 6–53. No unfavorable comments were received on the proposal to revise § 25.1501. Accordingly, the proposal is adopted without substantive change.

Proposal 6–54. For comments related to the proposal to revise § 25.1521(e), see Proposal 6–23.

Proposals 6–55 and 2–96. One commentator recommended that proposed § 25.1581(a)(2), which would require that the Airplane Flight Manual contain "Other information necessary for safety," be deleted. He stated that the proposed requirement would be far too broad, and could include all information now provided in the crew operating manual. The FAA agrees that the proposed wording may be too broad, but does not agree that all requirements for additional information should be eliminated. Section 25.1581(a)(2) as adopted requires other information that is necessary for safe operation because of design, operating, or handling characteristics. This wording is the same as current § 25.1581(c), except that the word "unusual" is deleted for the reasons stated in notice.

The same commentator also recommended deletion of proposed § 25.1581(b), which would require that each part of the manual containing required information be approved, segregated, identified, and clearly distinguished from each unapproved part of the manual. The commentator stated that he is not aware of any unapproved sections of the Airplane Flight Manual, and that the proposal implies a crew manual with the FAA limitation data so marked. The FAA does not agree with the recommended deletion of this requirement. The proposed paragraph is the same as current § 25.1581(b), and is intended to cover cases where the applicant desires to include information in the manual that is not required by the FAA.

Proposal 6–55 to amend § 25.1581 is adopted with the revisions discussed above.

The disposition of Proposal 2–96, which proposed to add a new § 25.1581(d) (Notice 75–10) was deferred so that it could be considered in connection with Proposal 6–55. No unfavorable comments were received on Proposal 2–96 and the proposal to add a new § 25.1581(d) is adopted without substantive change.

Proposal 6–56. For comments related to the proposal to amend § 25.1583, see Proposal 6–23.

Proposals 6–57 and 2–87. No unfavorable comments were received on the proposal to amend § 25.1585. Accordingly, the proposal is adopted without substantive change.

Disposition of Proposal 2–87 to amend § 25.1353 (Notice 75–10) was deferred so that it could be considered in connection with Proposal 6–57. Proposals 2–39, 2–131, and

2–186 to amend §§ 23.1353, 27.1353, and 29.1353, respectively (Notice 75–10), are substantively identical to Proposal 2–87 and all of these proposals are discussed below.

Commentators suggested that proposed §§ 25.1353(c)(5) and 29.1353(c)(5) be revised by adding the word "or" between paragraphs (c)(5)(i) and (c)(5)(ii) to allow an alternative design. The commentators misinterpreted the proposal. The sections as adopted provide for three alternatives with an "or" between paragraphs (c)(5)(ii) and (c)(5)(iii) and with an "or" understood between paragraphs (c)(5)(i) and (c)(5)(ii).

One commentator suggested that the proposals should be broadened to include nickel cadmium battery installations other than those capable of being used to start an engine or an auxiliary power unit. The proposals apply only to nickel cadmium batteries that are subject to a rapid drain because they are used to start an engine or auxiliary power unit. The FAA does not have enough information to indicate that in other installations the drain on nickel cadmium batteries is sufficiently rapid to require compliance with the proposed provisions.

One commentator objected to proposed §§ 27.1353(f) and 29.1353(c)(5) on the basis that the requirement should be limited to nickel cadmium batteries other than 20-cell batteries and to only certain battery locations. The commentator also stated that the requirement for helicopters should be different from that for airplanes since helicopters are able to execute an emergency landing much quicker than airplanes. The FAA has insufficient information at the present time to warrant any of the distinctions suggested by the commentator.

The FAA believes that the requirement in proposed § 25.1353(c)(5) concerning operating procedures in the Airplane Flight Manual should be transferred to § 25.1585(a), since that section pertains to operating procedures. The proposal for § 25.1353(c)(5) is revised and § 25.1585(a) amended accordingly. The remainder of proposed § 25.1353(c)(5) is redesignated § 25.1353(c)(6) in view of the adoption of a new § 25.1353(c)(5) in Amendment No. 5. The same revisions are also made to proposed §§ 23.1353(f), 27.1353(f), and 29.1353(c)(5), designated as §§ 23.1353(g), 27.1353(g), and 29.1353(c)(6), respectively, and to §§ 23.1585, 27.1585, and 29.1585.

Proposals 6–58 and 2–98. Proposed §§ 25.1587(c)(5) and (c)(6), which would add requirements for information on the vertical distance for transition to approach climb determined under proposed § 25.121(e) (Proposal 6–38), and on the en route net flight path data determined under proposed § 25.123 (Proposal 6–39), are withdrawn in view of the withdrawal of Proposals 6–38 and 6–39.

Disposition of Proposal 2–98 to revise § 25.1587 (Notice 75–10) was deferred so that it could be considered in connection with Proposal 6–58. No unfavorable comments were received on Proposal 2–98 and it is adopted as proposed except that the reference in proposed § 25.1587(b)(4) to § 25.101(c) is changed to reference §§ 25.101(f), (g), and (h). Current § 25.1587(c)(3), on which proposed § 25.1587(b)(4) is based, was adopted as part of the recodification of Part 4b of the Civil Air Regulations, effective February 1, 1965 (29 FR 18289). Specifically, § 25.1587 replaced § 4b.743 of the CARs and § 4T.743 of Special Civil Air Regulation 422B. Section 4T.743(c), which was replaced by § 25.1587(c)(3), referenced § 4T.111(c) and the requirements of § 4T.111(c) are now contained in §§ 25.101(f), (g), and (h), not § 25.101(c) as the current rule indicates. The purpose of the recodification program was simply to clarify the regulations. No substantive changes, other than relaxatory ones that were completely noncontroversial, were intended. The FAA believes that the change being made is a nonsubstantive editorial change since § 25.1587(c)(3) has been consistently interpreted in accordance with the rule as originally set forth in § 4T.743(c) of Special Civil Air Regulation 422B.

Proposal 6–59. For comments related to the proposal to amend § 27.25(b), see Proposal 6–5. The proposal to amend § 27.25(b) is adopted without substantive change.

Proposal 6–60. For comments related to the proposal to amend § 27.29, see Proposal 6–5.

Proposal 6–61. Proposed new §§ 27.33(e) and 29.33(e) (Proposal 6–77) would require a main rotor low-speed warning for each single engine helicopter and each multiengine helicopter that does not have an approved device that automatically increases power on the operating engines when one engine fails. Several commentators stated that operating experience does not indicate the need for a main rotor low-speed warning and that the instruments furnished the pilot are adequate to monitor rotor r.p.m. safely. One of these commentators also stated that if the warning is set high enough to be effective, the pilot will rely on it in lieu of monitoring rotor r.p.m. as he should and that the warning will activate during low r.p.m. transients which are entirely safe and this may cause pilot action that is unsafe. The commentator stated that since the National Transportation Safety Board (NTSB) has recommended an engine failure warning device on all turbine engines, this proposal should be withdrawn or deferred until action has been taken on the NTSB recommendations. The FAA does not agree. In regard to the comments concerning monitoring of instruments and rotor r.p.m. by the pilot, it should be noted that one of the main reasons for providing rotor low-speed warning is to assist the pilot in maintaining safe rotor speed after an engine failure when his attention is directed to flight path control and emergency procedures. With respect to activation of the warning during low-rotor r.p.m. transients, the FAA believes that the warning can be set to avoid nuisance warnings in normal maneuvers and still meet the requirements of this section. The NTSB Release for Safety Recommendations A-75-72 and 73, issued September 2, 1975, recommended that Parts 27 and 29 be amended to require that all turbine engine-powered helicopters be equipped with a prominent engine-out visual warning system and an aural warning system which can be heard with or without the use of a headset. The FAA believes, as stated in its response to the NTSB, that the proposed requirement for rotor low-speed warning is more desirable than an engine-out warning since a rotor low-speed warning would warn the pilot of an unsafe low rotor speed due to any cause, including engine failure, and will continue the warning function during power-off descent and landing.

One commentator noted that the FAA has imposed special conditions requiring engine-out warnings on certain turbine engine-powered helicopters, and stated that engine-out warnings should not be required in addition to rotor low-speed warning. The FAA does not believe it will be necessary to issue a special condition requiring installation of an engine-out warning on those helicopters with a rotor low-speed warning.

One commentator objected to the deletion of §§ 27.33(b)(3) and 29.33(b)(3). Current §§ 27.33(b)(1), (b)(2), and (b)(3) (and §§ 29.33(b)(1), (b)(2), (b)(3)) provide, for all rotorcraft, three alternative methods for showing that main rotor speeds substantially less than the minimum approved main rotor speed will not occur under any sustained flight condition with power on. One of the alternatives, paragraph (b)(3), is to provide adequate means to warn the pilot of unsafe main rotor speeds, but the proposal would delete this paragraph, thus requiring all rotorcraft to comply with paragraph (b)(1) or (b)(2). This was not the intent of the proposal. Accordingly, §§ 27.33(b)(3) and 29.33(b)(3) are retained. In addition, for clarification, the lead-in of §§ 27.33(b) and 29.33(b) are revised so that they are only applicable to rotorcraft that are not required to have a main rotor low-speed warning under § 27.33(e) or § 29.33(e), respectively.

Proposal 6-62. Two commentators objected to the proposals for §§ 27.45 and 29.45, stating that the basis for humidity levels has not been determined and varies between engines. These commentators further stated that there is no industry agreement on the effect of humidity on power or that humidity has a significant effect on power. The effects of humidity on the power of reciprocating engines are well understood and are generally the same between engine types. The effects of humidity on the power or thrust of turbine engines may differ between engine types. The proposal, however, establishes a reference humidity structure for the development of rotorcraft performance data. It does not prejudge the nature of the corrections, if any, which may be required. Each turbine engine must be evaluated to determine the effect of humidity on thrust or power, and, where rotorcraft performance is affected, it must be based on the humidity reference condition.

One commentator objected to the proposals on the basis that the humidity reference for turbine engine-powered rotorcraft may not be representative of average humidity conditions encountered in service. No safety problem has been identified with the use of the proposed humidity reference in the type certification of transport category airplanes, and the reference is considered equally valid for the type certification of rotorcraft.

One commentator questioned why a reciprocating engine-powered rotorcraft would be required to use a humidity correction different from that for turbine engine-powered rotorcraft. The humidity correction proposed for reciprocating engine-powered rotorcraft is similar to the current requirements for reciprocating engine-powered transport category airplanes and the proposed humidity correction for turbine engine-powered rotorcraft is similar to the current requirements for turbine engine-powered transport category airplanes, and the requirements for transport category airplanes have been administered without difficulty. In addition, the humidity correction requirements for turbine engine-powered rotorcraft are based on the fact that the power or thrust of turbine engines diminishes significantly as the ambient atmospheric temperature is increased. Power or thrust variations related to humidity could therefore have an adverse effect upon safety at temperatures above standard.

The proposal to revise § 27.45 and the proposal to amend § 29.45 are adopted without substantive change.

Proposals 6–63 and 2–100. Under proposed § 27.65(b)(2), if the never-exceed speed V_{NE} is less than the best rate-of-climb speed V_Y at any altitude within the range for which certification is requested, the steady rate of climb must be determined over the entire range of weights, temperatures, and altitudes for which certification is requested. One commentator recommended that the rate of climb information be required only for the range of altitudes where V_{NE} is less than V_Y, instead of the entire range of altitudes. The FAA disagrees. The climb performance and speed of a helicopter may change significantly below, as well as above, the altitude at which V_{NE} is less than V_Y. However, after further review, the FAA believes that it is only necessary that climb data be determined over the range of altitudes from 2,000 feet below the altitude at which V_{NE} is equal to V_Y up to the maximum altitude for which certification is requested. The proposal to amend § 27.65 is revised accordingly.

In addition, proposed § 27.65(b)(2)(i) is revised to allow the rate-of-climb to be determined at the climb speed selected by the applicant (instead of the most favorable climb speed) at or below V_{NE}. The FAA believes that the proposed paragraph (b)(2)(i) would impose an unnecessary burden on the applicant and result in complex operating information, since the most favorable climb speed may be a function of several variables.

Disposition of Proposal 2–100 to amend § 27.65(a)(2) (Notice 75–10) was deferred so that it could be considered in connection with Proposal 6–63. No unfavorable comments were received on the proposal to amend § 27.65(a)(2). Accordingly, the proposal is adopted without substantive change.

Proposal 6–64. Proposed § 27.67(c) would require the determination of the one-engine-inoperative steady rate of climb with maximum continuous power on the operating engines, and (for helicopters for which certification for the use of 30-minute power is requested) at 30-minute power. One commentator said that there is no need to show the climb performance data for both the maximum continuous and 30-minute power levels and, therefore, the word "and" preceding the parenthetical expression should be changed to "or". The FAA does not agree. Even though an applicant may request certification for the use of 30-minute power, climb performance data for maximum continuous power should be furnished to the pilot for use in operations that may require more than 30 minutes to reach a safe landing area after failure of one engine, e.g., over-water operations. Accordingly, § 27.67(c) is adopted without substantive change.

Proposal 6–65. No unfavorable comments were received on the proposal to revise § 27.75(a)(2)(ii). Accordingly, the proposal is adopted without substantive change.

Proposal 6–66. No unfavorable comments were received on the proposal to amend § 27.143. Accordingly, the proposal is adopted without substantive change.

Proposal 6–67. No unfavorable comments were received on the proposal to revise § 27.175(c). Accordingly, the proposal is adopted without substantive change.

Proposal 6–68. For comments related to the proposal to revise § 27.1043(b), see Proposal 6–23.

In addition, a nonsubstantive editorial change is being made to the lead-in of § 27.1043(a) to reference § 27.1041(b) instead of § 27.104(b).

Proposal 6–69. No unfavorable comments were received on the proposal to revise § 27.1501. Accordingly, the proposal is adopted without substantive change.

Proposals 6–70 and 2–135. Disposition of Proposal 2–135 to amend § 27.1545 (Notice 75–10) was deferred so it could be considered in connection with Proposal 6–70 to amend § 27.1505. No unfavorable comment was received on Proposal 2–135. Accordingly, the proposal is adopted without substantive change.

Proposed §§ 27.1505(c) and 29.1505(c) (Proposals 6–70 and 6–84, respectively) would allow the establishment of a never-exceed speed, V_{NE} (power-off), that is less than V_{NE} with power on, if V_{NE} (power-off) is not less than a speed midway between the power-on V_{NE} and the speed for maximum range in autorotation at maximum weight. One commentator recommended that "V_Y or the climb speed selected by the applicant in demonstrating compliance with the climb requirements" be inserted in proposed § 27.1505(c) in place of the speed for maximum range in autorotation. The commentator stated that since determination of the speed for maximum range in autorotation is not presently required, the substitution of the climb speed (which is determined under the climb requirements in §§ 27.65 or 27.67) would accomplish the intent of placing a lower limit on V_{NE} (power-off) without unnecessary additional demonstration requirements.

After further consideration, the FAA believes that the speed used in determining climb performance (one-engine-inoperative climb performance, if applicable) should be used in establishing a V_{NE} (power-off) for both Part 27 and 29 helicopters, instead of the speed for maximum range in autorotation at maximum weight. The speed midway between power-on V_{NE} and the appropriate climb speed is expected to be high enough to provide the pilot with an adequate range of speeds and glide angles during autorotation. In addition, the determination of V_{NE} (power-off) will be based on information already required to be furnished by the applicant which would not be the case if the speed for maximum range in autorotation were prescribed since it is only required to be determined for certain Part 29 Category B helicopters. The proposals to amend §§ 27.1505 and 29.1505 are revised accordingly.

Proposal 6–71. For comments related to the proposal to add a new § 27.1521(f), see Proposal 6–23.

Proposal 6–72. No unfavorable comments were received on the proposal to add a new § 27.1527. Accordingly, the proposal is adopted without substantive change.

[For discussion concerning the amendment of § 27.1545, see Proposals 6–70 and 2–135.]

Proposals 6–73, 2–139 and 2–140. No unfavorable comments were received on Proposal 6–73 to amend § 27.1581. The proposal is adopted without substantive change, except that proposed § 27.1581(a)(2) is revised in accordance with the discussion of the proposal to amend § 25.1581 (Proposal 6–55).

Disposition of Proposals 2–139 to amend § 27.1581 and 2–140 to amend § 27.1587 was deferred so that these proposals could be considered in connection with Proposal 6–73. No unfavorable comments were received on Proposal 2–139 or Proposal 2–140. Proposal 2–139 to amend § 27.1581 is adopted without substantive change. For reasons that are stated in the discussion of Proposal 6–23 for § 23.1521(e), Proposal 2–140 to amend § 27.1587 is revised by adding a new § 27.1587(a)(2)(iii) requiring information on the maximum ambient atmospheric temperature at which compliance with the cooling requirements was shown. Additionally, the parenthetical phrase "(if provided)" is deleted from § 27.1587(b) since the amendment to § 27.1581 requires that a Rotorcraft Flight Manual be furnished for each rotorcraft. The proposal to amend § 27.1587 is adopted with the changes discussed above.

Proposal 6–74. For comments related to the proposal to amend § 27.1583, see Proposal 6–23.

Proposals 6–75 and 2–131. Proposed §§ 27.1585(c) and 29.1585(c) would require the operating procedures section of the Rotorcraft Flight Manual to contain information on the procedures for reducing airspeed to V_{NE} (power-off) for helicopters for which a V_{NE} (power-off) is established under §§ 27.1505(c) and 29.1501(c), respectively. One commentator stated that he did not favor systematically placing explicit engine, altitude, and V_{NE} (power-off) limitations in the "limitations" chapter of the Flight Manual. The commentator apparently misinterpreted the proposal, as it would affect only the operating procedures section, not the limitations section. The commentator also stated that these explanations should only be required when they bring significant information to the pilot and when the limitation results from an indirect and not an obvious cause. The

FAA believes that in view of the surprise element that may be associated with engine failure in service operations, the procedure for reducing airspeed to not more than V_{NE} (power-off) should be furnished for each helicopter for which a V_{NE} (power-off) is established. Accordingly, the proposals for §§ 27.1585(c) and 29.1585(c) are adopted without substantive change.

Disposition of Proposal 2–131 to amend § 27.1353 (Notice 75–10) was deferred so that it could be considered in connection with Proposal 6–73. For comments related to proposed § 27.1353(f) and for an explanation of the revision to proposed § 27.1353(f), see the discussion of Proposal 2–87 under Proposal 6–57.

Proposal 6–76. For comments related to the proposal to amend § 29.29, see Proposal 6–5.

Proposal 6–77. For comments related to the proposed amendment of § 29.33, see Proposal 6–61 for § 27.33.

Proposal 6–78. For comments related to proposed § 29.45, see Proposal 6–62.

Proposal 6–79. One commentator recommended that proposed § 29.65(c) be revised to require climb data only for those altitudes where V_{NE} is less than V_y at sea level. For a discussion of this comment and the explanation for the revisions to proposed § 29.65(c), see Proposal 6–63. This commentator also stated that proposed § 29.65(c) is superfluous for Category B rotorcraft since it duplicates the requirement of proposed § 29.65(a)(4). The FAA agrees that some clarification is needed and proposed § 29.65(a) and (c) are revised to list all of the Category B requirements in paragraph (a) and to make paragraph (c) applicable only to Category A helicopters. For an explanation of the revisions to proposed § 29.65(c)(1), see the discussion of the revision to proposed § 27.65(b)(2)(i) under Proposal 6–63. Accordingly, the proposal is adopted with the revisions discussed above and under Proposal 6–63.

Proposal 6–80. No unfavorable comments were received on the proposal to amend § 29.143. Accordingly, the proposal is adopted without substantive change.

Proposal 6–81. No unfavorable comments were received on the proposal to revise § 29.175(c). Accordingly, the proposal is adopted without substantive change.

Proposal 6–82. For comments related to the proposal to revise § 29.1043(b), see Proposal 6–23.

Proposal 6–83. No unfavorable comments were received on the proposal to revise § 29.1501. Accordingly, the proposal is adopted without substantive change.

Proposals 6–84 and 2–188. For comments related to Proposal 6–84 to amend § 29.1505, and for an explanation of the revisions to proposed § 29.1505(c), see Proposal 6–70.

Disposition of Proposal 2–188 to amend § 29.1545 (Notice 75–10) was deferred so that it could be considered in connection with Proposal 6–84 to amend § 29.1505. No unfavorable comments were received on Proposal 2–188. Accordingly, the proposal is adopted without substantive change.

Proposal 6–85. For comments related to the proposal to revise § 29.1521(e), see Proposal 6–23.

Proposal 6–86. No unfavorable comments were received on the proposal to add a new § 29.1527. Accordingly, the proposal is adopted without substantive change.
[For discussion concerning the amendment of § 29.1545, see Proposals 6–84 and 2–188.]

Proposals 6–87 and 2–192. Proposal 6–87 proposed to revise § 29.1581(a) and (b) and to delete § 29.1581(c) and mark it "[Reserved]." Disposition of Proposal 2–192 to add a new § 29.1581(d) (Notice 75–10) was deferred so that it could be considered in connection with Proposal 6–87.

No unfavorable comment was received on Proposals 6–87 or 2–192. These proposals to amend § 29.1581 are adopted without substantive change except that proposed § 29.1581 (a)(2) is revised in accordance with the discussion of the proposal to amend § 25.1581 (Proposal 6–55).

Proposal 6–88. For comments related to the proposal to amend § 29.1583, see Proposal 6–23.

Proposals 6–89 and 2–186. For comments related to Proposal 6–89 to add a new § 29.1585(c), see Proposal 6–75.

Disposition of Proposal 2-186 to amend § 29.1353 (Notice 75-10) was deferred so that it could be considered in connection with Proposal 6-89. For comments related to proposed § 29.1353(c), see the discussion of Proposal 2-87 under Proposal 6-57.

Proposal 6-90. No unfavorable comments were received on the proposal to amend § 91.31. Accordingly, the proposal to amend § 91.31 is adopted without substantive change.

Proposal 6-91. The proposal to amend § 91.37 was made to implement Proposals 2-49, 2-51, 2-52, and 2-93 to amend §§ 25.105, 25.125, 25.241 and 25.1533, respectively, contained in Airworthiness Review Notice No. 2 (Notice 75-10). Since the proposed amendments to Part 25 have been withdrawn (41 FR 55454), Proposal 6-91 is also withdrawn.

Proposal 6-92. Proposed § 121.141(b) would authorize an air carrier to revise the operating procedures and the format of the performance data for the applicable Airplane or Rotorcraft Flight Manual and include the revised information in the operator's manual required by § 121.133, if the revised procedures and performance data presentation are approved by the Administrator and are clearly identified as flight manual requirements. One commentator said that there was no need for the identification of the flight manual material. This requirement is in the current rule and the FAA does not have sufficient information at the present time to justify deleting it, especially with regard to the operating limitations.

The commentator also suggested that the second sentence of proposed § 121.141(b) would be clarified by inserting a clause indicating that if the certificate holder elects to carry the manual required by § 121.133, he must retain all of the limitations section (of the flight manual) as written, unless deviations are specifically authorized by the Administrator. The FAA does not believe that the suggested change is necessary or appropriate. Proposed § 121.141(b) would not authorize a change in the substance or presentation of the operating limitations required for the applicable flight manual. Accordingly, the proposal to revise § 121.141(b) is adopted without substantive change.

DRAFTING INFORMATION

The principal authors of this document are Paul C. Spiess and Charles J. Maple, Flight Standards Service, and Keith S. May, Office of the Chief Counsel.

ADOPTION OF THE AMENDMENT

Accordingly, Parts 1, 21, 23, 25, 27, 29, 91, and 121 of the Federal Aviation Regulations are amended, effective March 1, 1978.

(Secs. 313(a), 601, 603, 604, and 605 of the Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421, 1423, 1424, and 1425); and sec. 6(c) of the Department of Transportation Act (49 U.S.C. 1655(c)).)

NOTE.—The Federal Aviation Administration has determined that this document does not contain a major proposal requiring preparation of an Economic Impact Statement under Executive Order 11821, as amended by Executive Order 11949, and OMB Circular A-107.

Amendment 27-15

Operations Review Program; Amendment No. 6: General Operating and Flight Rules and Related Airworthiness Standards and Crewmember Training

Adopted: September 28, 1978 **Effective: December 5, 1978**

(Published in 43 FR 46230, October 5, 1978)

SUMMARY: The purpose of these amendments is to update and improve certain requirements applicable to aircraft, training programs, and airmen. These amendments are part of the Operations Review Program.

FOR FURTHER INFORMATION CONTACT:

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SUPPLEMENTARY INFORMATION:

HISTORY

These amendments are the sixth in a series of amendments to be issued as part of the Operations Review Program. The following amendments of the series have previously been issued as part of the Operations Review Program:

Title	*FR Citation*
Clarifying and Editorial Changes	(41 FR 47227; October 28, 1976)
Rotorcraft External-Load Operations	(42 FR 24196; May 12, 1977 amended by 42 FR 32531; June 27, 1977)
Airspace, Air Traffic and General Operating Rules	To be issued at a later date)
Development of Major Repair Data	(43 FR 3084; January 23, 1978)
Miscellaneous Amendments	(43 FR 22636; May 25, 1978)
Certification and Operations: Domestic, Flag, and Supplemental Air Carriers and Commercial Operators of Large Aircraft	(43 FR 22643; May 25, 1978 amended) by 43 FR 28403; June 29, 1978)

These amendments are based on a Notice of Proposed Rule Making (Notice 77-20) published in the Federal Register on September 1, 1977 (42 FR 44204). All interested persons have been given an opportunity to participate in the making of these amendments and due consideration has been given to all matters presented. A number of substantive changes and changes of an editorial and clarifying nature have been made to the proposed rules based upon relevant comments received and upon further review by the FAA. Except for minor editorial and clarifying changes and the substantive changes discussed below these amendments and reasons for their adoption are the same as those contained in Notice 77-20.

DISCUSSION OF COMMENTS

The following discussions are keyed to like-numbered proposals in Notice 77-20 and amendments to §§ 121.417, 121.437 and 121.439. Since these amendments to §§ 121.417, 121.437 and 121.439 are clarifying and relaxatory in nature and do not impose a burden on the public, I find that notice and public procedure are unnecessary and that the amendments may be effective without notice.

Proposal 6-1. Proposed § 91.33(b)(12) would require that safety belts have metal to metal buckles or latching devices. Implementation of this amendment necessitates corollary amendments to the airworthiness provisions of §§ 23.1413, 25.1413, 27.1413 and 29.1413.

Most commenters favored the proposal with some of the commenters suggesting various effective dates for compliance, ranging from one to five years instead of the two-year period proposed. These suggestions were based on consideration of equipment availability and the economic burden of purchasing the new type safety belts. Considering these comments, the FAA concluded that a three-year period for compliance will suffice and the final rule is amended accordingly. One commenter asked whether the "metal to metal" requirement applied to both buckles and latching devices. After further review, the FAA believes that the requirement could be misinterpreted. Since a "buckle" is a "latching device", the word "buckle" is deleted in the rule.

One commenter noted that current § 91.33(b)(12) uses the plural form when referring to "occupants" and "belts". Since it was not FAA's intention to change the current rule in this regard, the plural form is retained.

Proposal 6-2. The proposed revision of § 25.1413 would reflect, in the airworthiness standards, amendments made to § 91.33. See the discussion for Proposal 6-1.

Proposal 6-3. The proposed revision of § 27.1413 would reflect, in the airworthiness standards, amendments made to § 91.33. See the discussion for Proposal 6-1.

Proposal 6-4. The proposed revision of § 29.1413 would reflect, in the airworthiness standards, amendments made to § 91.33. See the discussion for Proposal 6-1.

Proposal 6-5. The proposed revision to § 91.4 would have required a person who releases an aircraft for flight to another person to first determine who intends to serve as pilot in command and to then determine that the pilot in command has current certificates and ratings as required in the regulations.

A large majority of the comments received were unfavorable. Many commenters objected to the proposal on the basis that current rules make the pilot responsible for being properly certificated and rated for the operation intended and the implementation of one regulation to assist in the enforcement of another is not only unnecessary but would impose an economic burden on the industry.

One commenter said the added responsibility imposed upon the "releasor" would involve third parties in possible litigation and the additional inspections would not bring about an increase in safety commensurate with the effort required. Another commenter questioned whether, in light of the wording of § 61.3(h) which limits who can request a person to present his certificate for inspection, the Administrator can, in another rule, designate inspection responsibility to everyone who uses, causes to use, or authorizes the use of aircraft.

A few commenters called attention to the fact that it is just good business to assure that the person to whom they lease aircraft is properly certificated, but there is not sufficient justification to make the lessor responsible for determining all aspects of a pilot's currency.

After consideration of all the comments received and after further review, the FAA believes that there exists insufficient justification to amend the regulations as proposed. Accordingly, the proposal to amend § 91.4 is withdrawn.

Proposal 6-6. Current § 91.14 requires the pilot in command to ensure that each person on board has been notified, before each takeoff and landing, to fasten that person's safety belt. The proposal would require the pilot in command of the aircraft to ensure that each person on board is briefed on how to fasten and unfasten that person's safety belt.

A number of commenters incorrectly concluded that the proposed rule would require the pilot in command to personnally conduct the briefing. The proposed rule would only require the pilot in command to ensure that the passengers are briefed.

One commenter stated that the pilot in command could brief the passengers in the event of an emergency. The FAA believes that, when an emergency develops, the pilot in command would not have the time to brief passengers on how to buckle and unbuckle their safety belts.

A few commenters stated that anybody familiar with automobile seat belts should know how to fasten and unfasten airplane safety belts and, therefore, the briefing is unnecessary. The FAA does not agree. Certain aircraft safety belts are different from those used in automobiles and it cannot be assumed that all passengers are familiar with automobile safety belts.

Since the pilot in command is currently responsible to ensure that persons are notified to fasten their safety belts, the FAA believes that little additional effort will be involved for the pilot in command to also ensure that persons on board are briefed on how to fasten and unfasten their safety belts. Accordingly, § 91.14 is amended as proposed.

Proposal 6–7. Current § 91.21 prohibits a person from operating a civil aircraft for flight instruction unless that aircraft has fully functioning dual controls. The proposed rule would allow the use of a single, functioning, throwover control wheel for instrument flight, instrument flight instruction and simulated instrument flight. The FAA received a large number of favorable responses to this proposal and it is adopted without change.

Proposal 6–8. This proposal would move the 30 minute VFR day fuel reserve requirement, now prescribed in § 91.207 (which applies to large and turbojet-powered multiengine airplanes), to a new § 91.22 so that this requirement would apply to all airplanes. Additionally, fuel requirements would be added for night VFR flight and rotorcraft operations.

Although a number of commenters supported the proposed amendment, a larger number disagreed. Some of those who disagreed stated that the proposed amendment was an attempt to legislate safety in an area which has been governed by common sense. Judging from the increasing number of fuel exhaustion accidents which occur each year, the FAA believes there must be a more precise means to determine an adequate fuel reserve for VFR flight.

A few commenters stated that the fuel requirements are already contained in § 91.5 and that proposed § 91.22 was, therefore, redundant. Section 91.5 requires the pilot to be informed regarding "fuel requirements". It does not, however, contain a requirement for fuel reserves beyond the first point of intended landing.

Three commenters favored simplification of the regulation by making the fuel reserves the same for both day and night. One of the commenters favored one hour and two favored 30 minutes for both. The FAA believes that the distance between adequately lighted airports warrants the additional fuel reserves for night VFR operation.

One commenter recommended that § 91.22 be made consistent with § 91.23 by using the term "civil aircraft" instead of "airplane" in § 91.22. The FAA agrees and the term "civil aircraft" is used in the title to § 91.22.

One commenter suggested that the phrase "normal cruising speed" be used rather than "normal cruising fuel consumption" to make the nomenclature the same as in § 91.23(c). The FAA agrees, and § 91.22, as adopted, is revised accordingly.

Proposal 6–9. The purpose of proposed § 91.23 was to simplify flight planning by eliminating the reference to minimum obstruction clearance altitude (MOCA) and minimum en route IFR altitude (MEA). A number of commenters said that the proposed revision was somewhat simpler than the current rule but that it was still cumbersome. They suggested that it would be much simpler if criteria were established which would require the pilot to determine only that a certain ceiling and visibility would exist one hour before and one hour after the estimated time of arrival at the airport of first intended landing. Most commenters supported a ceiling of 2,000 feet above the airport elevation and three miles visibility. However, a number of commenters recommended ceilings of 2,500 and 3,000 feet and one commenter suggested a visibility of four miles. After further review, the FAA believes that, in the interest of simplicity, this proposal should be modified to require only a ceiling of 2,000 feet above the airport elevation and three miles visibility for the period one hour before and one hour after the estimated time of arrival at the first airport of intended landing.

Another commenter stated that the proposed rule would do little or nothing for safety and would be almost immpossible to enforce. The FAA does not agree. The FAA believes that the amendment was designed to provide a simpler and less restrictive means for determining fuel requirements and that the amendment is enforceable.

Additionally, § 91.83(b) is amended to make the information required for a flight plan consistent with the ceiling and visibility requirements of § 91.23 as adopted. See Proposal 6-16.

One commenter suggested that the word "applicable", as used in § 91.23(b)(2)(ii), should be explained. Since § 91.23, as adopted, deletes the reference "applicable visibility minimums", this no longer presents a problem. Section 91.23, as adopted, is revised accordingly.

Proposal 6-10. Current § 91.25(a)(2) requires an operational check of the VOR within the preceding ten hours of flight time and within ten days before flight. Proposed § 91.25(a)(2) and (d) would delete the ten day requirement and predicate the VOR equipment check requirement on ten hours of flight time. Numerous commenters pointed out that it would be inconsistent to refer to flight time in § 91.25(a)(2) and to refer, in § 91.25(d), to "tachometer time" and "aircraft time". A number of commenters suggested that only days be used as the guide and a period of 30 days to 90 days would be feasible considering the improved reliability of VOR equipment and the need to reduce the aircraft operator's recordkeeping burden. The FAA agrees. Accordingly, proposed § 91.25(a)(2) is revised to require that the VOR equipment be checked at least every 30 days rather than after ten hours of flight time. Since § 91.25(a)(2), as adopted, no longer contains a reference to flight time, there is no longer a need to amend § 91.25(d) to require tachometer time, or, in its absence, aircraft time to date. Accordingly, these references are deleted. The FAA believes, after further consideration, that there would be no useful purpose in retaining a permanent record of the VOR equipment check. Therefore, the word "permanent" is deleted in both places where it appears in § 91.25(d), as adopted.

Proposal 6-11. Proposed § 91.29 would require the pilot in command of a civil aircraft to enter in the aircraft log and maintenance record of the aircraft any mechanical discrepancy noted during flight. The majority of commenters opposed the proposed amendment. They stated that the log and maintenance records are permanent records which should not be cluttered with discrepancies noted by the pilot, the term discrepancy is not defined and, as worded, the proposed amendment stipulates that the discrepancy must be entered in both the aircraft log and maintenance record. They also stated that the proposed rule is unenforceable, the proposed amendment would require the pilot/owners to write a note to themselves and persons operating under Part 121, 123, 127 and 135 have established procedures for reporting mechanical irregulatities.

After further review and careful consideration of all the comments, the FAA believes that the current regulations are adequate and proposed § 91.29 is withdrawn.

Proposal 6-12. This proposal would amend § 91.33(b)(12 to require safety belts to have metal latching devices. See the discussion for Proposal 6-1. One commenter called our attention to the fact that current § 91.33(b)(12) states ". . . approved seat belts for all occupants . . ." whereas the proposed amendment states ". . . for each occupant . . .". Since it was not our intention to make this change the proposal has been amended to use the wording of the current rule.

Proposal 6-13. This proposal would mean § 91.36(b) to require that the equipment be tested to the maximum operating altitude of the aircraft. Almost all of the comments received were favorable. ne commenter asked what is meant by maximum operating altitude and stated that a definition is needed somewhere. The definition is contained in §§ 23.1527, 25.1527, 27.1527 and 29.1527 which describe maximum operating altitude limitations. These limitations are also contained in the aircraft flight manual. The proposed amendment is adopted without change.

Proposal 6-14. Proposed § 91.45(a)(3)(ii) would allow a takeoff on a wet runway with one engine inoperative based solely on engineering findings. Several commenters objected to this proposal, contending that the initial approval must be based upon demonstration under actual conditions. Other commenters stated that one engine inoperative takeoffs from a wet runway should not be allowed on the basis of analytical data alone. In view of these comments and after further review, this proposal is withdrawn.

Proposal 6-15. Proposad § 91.54(a)(2) would require a typed or printed name and address and the signature of the person responsible for operational control of large aircraft. Two comments concurred with the proposal as written.

One commenter stated it was not necessary for the government to regulate the manner in which a form is completed. The commenter further stated that if the form is not completed in a manner acceptable to the FAA, it should be refused. The FAA believes that it should regulate the manner in which the form is completed and that the person making out the form should know in advance what is acceptable to the FAA. Accordingly proposed § 91.5(a)(2) is adopted without substantive change.

Proposal 6-16. Proposed § 91.83(b) as adopted, makes the information required for a flight plan consistent with the ceiling and visibility requirements of amended § 91.23. See the discussion for Proposal 6-9.

Proposal 6-17. The proposed change to § 91.193 would require a hand fire extinguisher in the passenger compartment of each airplane accommodating less than 31 passengers.

The commenters who opposed the rule change stated that the fire extinguisher would add unnecessary weight to the aircraft, would discharge all over the cabin when used, and would create a hazard if it became loose during turbulence. One commenter said that small airplanes which carry up to six passengers usually operate at lower altitudes and can, therefore, be landed readily if an in-flight fire starts.

Another commenter had never heard of an in-flight fire except an engine fire, and that a fire extinguisher in the cabin would be of no help in such a situation. In view of the comments and after review, this proposal is withdrawn.

Proposal 6-18. Proposed § 91.201(b) would require a sideward restraint for under seat baggage. Commenters who opposed the proposed amendment cited the installation costs, extra weight, and out-of-service time for installation of such restraining devices. The FAA believes the costs and added weight would be minimal and justified considering the improved safety provided. After further review, the FAA believes that the operator should be given additional time to install these restraint devices. Accordingly, this amendment provides a compliance date of one year from the effective date of this amendment. Since the operator has been given one year to make these installations, there should be little or no disruption of flight operations. Commenters also contended that since, in an emergency, most of the forces are forward, there is little tendency for the baggage to move sideward, and, in emergency evacuation demonstrations conducted by the airlines, items of mass placed in the aisle were found to create no delay. The FAA believes that these commenters limited their observations to crash landings where the motion would be forward. Severe turbulence may also create a potential hazard to passengers when large articles become dislodged. The FAA cannot agree that, in emergency evacuation demonstrations, items of mass cause no delay. They cause delay when placed in the aisles during evacuation tests to simulate actual conditions caused by unrestrained under seat items moving into the aisles during a crash landing. Several commenters in favor of the proposal stated that they had observed under seat baggage that moved sideward blocking the aisles during heavy turbulence or emergencies.

Accordingly, § 91.201(b) is adopted as proposed with the delayed compliance date as noted.

Proposal 6-19. The proposed deletion of § 91.207 is related to the proposal for a new § 91.22 (See the discussion for Proposal 6-8) which would make the requirement for fuel reserves of 30 minutes for day VFR and 45 minutes for night VFR applicable to all airplanes operated under Part 91. No commenters objected to the deletion of current § 91.207 if new § 91.22 is adopted. Since § 91.22 is adopted, § 91.207 is deleted.

Proposal 6-20. No opposing comments were received concerning proposed § 91.213(c). Accordingly, § 91.213(c) is adopted as proposed.

AMENDMENT TO § 121.417

Amendment No. 121-144 (43 FR 22643; May 25, 1978) amended the crewmember emergency training provisions of § 121.417 by requiring each crewmember to actually operate each item of equipment required for the deployment and use of emergency evacuation slides. However, as stated in Notice No. 77-12 (42 FR 37417), while flight attendants would be required to operate the associated escape devices during initial and recurrent training, automatic and manual escape chutes need not be deployed each time that the associated exit is cycled.

However, since publication of Amendment No. 121-144, it has come to the attention of the FAA that this amendment could be given an overly restrictive interpretation and that further clarification is necessary. Accordingly, this amendment revises § 121.417(c) to make it clear that the emergency drill requirements prescribed for crewmembers apply to both initial and recurrent training. Also, it more clearly specifies that each crewmember is not required to actually operate (removal, transfer or inflation of the life raft, or slide/raft pack) the equipment specified in paragraphs (c)(6)(v), (c)(6)(vi), and (c)(6)(vii) during emergency drills. Additionally, this amendment clarifies the fact that the evacuation slide need be used only once during each training phase.

Finally, the phrase "or training device" has been inserted in §§ 121.417(c)(6)(v) and (vii) respectively to clarify the fact that the training specified may be conducted in a training device.

Since this amendment is relaxatory and clarifying in nature and does not impose a burden on the public, I find that notice and public procedure are unnecessary and this amendment may be made effective without notice.

AMENDMENT TO § 121.437

Amendment No. 121-144 (43 FR 22643; May 25, 1978) amended § 121.437(b) to require pilots to hold a category and class ratings appropriate for the type of aircraft being used. After the amendment to § 121.437(b) became effective, the FAA was informed by the Air Transportation Association (ATA) that the amendment would be extremely costly and very difficult for the airlines to comply within the specified time, as it would require the airlines to provide aircraft flight checks for more than 5,000 pilots to obtain the required category and class ratings. Consequently, the effective date of § 121.437(b) was extended to July 1, 1980, by Amendment No. 121-146 (43 FR 28403; June 29, 1978).

In addition, ATA stated the training provided to pilots, other than pilots in command, under the provisions of Part 121 and the proficiency checks requirements of § 121.441 are equivalent to the standards required for a commercial pilot to obtain an airplane category and class rating.

Accordingly, § 121.437(b) is amended to allow pilots who are currently employed by a certificate holder and have satisfactorily completed the approved training program under Subpart O, including the proficiency flight check required by § 121.441, of this Part, to be issued the appropriate category and class rating by presenting proof of compliance with those requirements to an Air Carrier or Flight Standards District Office. The FAA believes that this amendment would provide an equivalent level of safety.

To delay this amendment would pose an undue burden to the certificate holders and pilots affected by the amendment. For this reason, the FAA has determined notice and public procedure hereon are impractical and contrary to the public interest.

AMENDMENT TO § 121.439

Amendment No. 121–144 (43 FR 22643; May 25, 1978) amended § 121.439(c)(2) to require pilots to be currently qualified in another airplane of the same group prior to that pilot receiving recency of experience training in a visual simulator.

After further review, the FAA believes that this requirement is too restrictive in that it would not allow certificate holders that operate only one type of airplane in the same group to allow their pilots to use a visual simulator to reestablish recency of experience requirements, as it would be impossible for their pilots to be dual qualified, or currently qualified in another airplane of the same group. This amendment deletes § 121.439(c)(2) and allows use of the visual simulator to reestablish recency of experience requirements. As these changes are relaxatory and clarifying in nature and do not impose a burden on the public, notice and public procedure are unnecessary and these changes are adopted as noted.

ADOPTION OF THE AMENDMENTS

Accordingly, Parts 23, 25, 27, 29, 91, and 121 of the Federal Aviation Regulations (14 CFR Parts 23, 25, 27, 29, 91, and 121 are amended effective December 4, 1978, except for Section 121.417 which is effective September 29, 1978.

Sections 313, 314, and 601 through 610 of the Federal Aviation Act of 1958 (49 U.S.C. 1354, 1355, and 1421 through 1430) and section 6(c) of the Department of Transportation Act (49 U.S.C. 1655(c)).

Amendment 27–16

Airworthiness Review Program Amendment No. 7: Airframe Amendments

Adopted: October 20, 1978 **Effective: December 1, 1978**

(Published in 43 FR 50578, October 30, 1978)

SUMMARY: The purpose of these amendments to the Federal Aviation Regulations is to update and improve the airframe and crashworthiness standards applicable to the type certification of aircraft, and to make related changes to the operating rules contained in Part 121. These amendments are part of the Airworthiness Review Program.

FOR FURTHER INFORMATION CONTACT:

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SUPPLEMENTARY INFORMATION: These amendments are the seventh in a series of amendments to be issued as part of the Airworthiness Review Program. The following amendments have previously been issued as part of this Airworthiness Review Program:

Title—FR citation

Form number and clarifying revisions (40 FR 2576; Jan. 14, 1975).
Rotorcraft anticollision light standards (41 FR 5290; Feb. 5, 1976).
Miscellaneous amendments (41 FR 55454; Dec. 20, 1976).
Powerplant amendments (42 FR 15034; Mar. 17, 1977).
Equipment and systems amendments (42 FR 36960; July 18, 1977).
Flight amendments (43 FR 2302; Jan. 16, 1978).

The amendments now being issued are based on five Notices of Proposed Rulemaking—Notice 75–10, published in the FEDERAL REGISTER on March 7, 1975 (40 FR 10802); Notice 75–19 published in the FEDERAL REGISTER on May 19, 1975 (40 FR 21866); Notice 75–23 published in the FEDERAL REGISTER on May 27, 1975 (40 FR 23048); Notice 75–26 published in the FEDERAL REGISTER on June 10, 1975 (40 FR 24802); and Notice 75–31 published in the FEDERAL REGISTER on July 11, 1975 (40 FR 29410).

The amendments based on Notice 75–10 were deferred in the series of amendments titled "Miscellaneous Amendments" so that they could be considered with the final disposition of certain proposals in Notices 75–23, 75–26, and 75–31. The amendments based on Notice 75–19 were deferred in the series of amendments titled "Powerplant Amendments" so that they could be considered with the final disposition of certain proposals in Notice 75–31. The amendments based on Notice 75–23, including the related amendments based on Notice 75–10, were deferred in the series of amendments titled "Equipment and Systems Amendments" for further consideration and review.

The amendments based on Notice 75–31, and the related amendments based on Notices 75–10, and 75–19, implement the rotorcraft proposals or parallel proposals for the other aircraft airworthiness Parts. These proposals were brought forward for consideration with the final disposition of the proposals in Notice 75–26 in order to dispose of all the outstanding rotorcraft proposals and allow the announcement of a rotorcraft regulatory review. The discussions of the comments received for the deferred proposals from Notice 75–10 are included under the heading of the related proposals from Notices 75–23, 75–26, and 75–31. The discussions of the comments received for the deferred proposals from Notice 75–19 are included under the heading of the related proposals from Notice 75–31.

Interested persons have been afforded an opportunity to participate in the making of these amendments and due consideration has been given to all matter presented. A number of substantive changes and changes of an editorial and clarifying nature have been made to the proposed rules based upon relevant comments received and upon further review within the FAA. Except for minor editorial and clarifying changes and the substantive changes discussed below, these amendments and the reasons for them are the same as those contained in Notices 75–10, 75–19, 75–23, 75–26, and 75–31.

DISCUSSION OF COMMENTS

The following discussion is keyed to like-numbered proposals contained in Notices 75-23, 75-26, and 75-31, and is presented in the same order as the corresponding amendments to be found in the rules portion of this document.

Proposal 7-1. One commentator recommended that the 25 feet per second head-on gust requirement in proposed § 23.345(c) be deleted because there had been no recorded failures of any flaps or flap structure attributed to head-on gusts and the proposal would increase the power-off flap loads. The FAA believes that a majority of the recorded flap and flap support structural failures resulted from head-on gusts. The amendment to § 23.345(c) is adopted without substantive change.

Based on the comments received and upon further review within the FAA, the proposal for new § 23.345(f) is withdrawn.

Proposal 7-2. One commentator objected to the proposal to amend § 23.561(b)(2) to require a 3.0g rearward ultimate inertial load for seat attachment design. The commentator stated that it is unreasonable to expect rearward inertia forces that are twice the sideward and equal to upward inertia forces. Upon further review, the FAA believes that it does not have enough information at this time to specify the minimum value to be used as a rearward ultimate inertia force. The proposal is withdrawn. However, the proposal to add a new § 23.785(h) concerning seat track retention is adopted. See Proposal 7-11.

Proposal 7-3. Several commentators objected to the proposal to amend § 23.603 and to similar proposals to amend §§ 25.603, 27.603, and 29.603. These proposals would require the applicant to show that the materials used for safety-critical parts will maintain their design properties throughout their service lives, taking into consideration the environmental considerations expected in service. The commentators stated that there is no satisfactory means of showing compliance for many materials. The limiting factors in achieving this objective were stated to be as follows: (1) A complete definition of the operating environment; (2) an understanding of interactive effects, and (3) test methods which correlate with service. After consideration of the comments received, and after further review of the materials used on modern aircraft, the FAA agrees that there may be significant difficulties in developing means to show compliance with the proposed amendments. The FAA believes, however, that the design characteristics of some materials used on aircraft may be affected by environmental conditions and that, where such materials are used in safety-critical parts, the effects of the environment upon them must be considered. The FAA further believes that the term "environmental conditions" should be clarified.

Accordingly, the proposals to add new §§ 23.603(a)(3), 25.603(c), 27.603(c), and 29.603(c) are revised to require only that the suitability and durability of materials used for safety-critical parts must take into account the effects of environmental conditions, such as temperature and humidity, expected in service.

Two commentators, while agreeing with the proposal for § 25.603, stated that the proposed requirement should apply also to fabrication methods. The FAA does not have any information at this time to indicate that the change recommended by these commentators is necessary, and the commentators did not provide any. These commentators also suggested that the term "design values" be substituted for the proposed term "design properties" to let the designer anticipate deterioration. The FAA believes that the change suggested by these commentators is unnecessary in view of the revision made in the rule as adopted.

Two commentators stated that the proposal for § 27.603(c) is not needed since the proposed requirements appear to be covered in present § 27.609. The FAA does not agree. Section 27.609 requires that each part of the structure must be protected from deterioration or loss of strength in service due to any cause, including weathering, corrosion, and abrasion, and it further requires provisions for ventilation and drainage where necessary for protection. Proposed new § 27.603(c) is concerned with the suitability of materials which may undergo changes in design characteristics, regardless of the degree of protection that is provided them.

One commentator objected to the proposal for § 27.603, stating that the subject material is adequately covered in §§ 27.613 and 27.619. The FAA does not agree. The practical effect of § 27.613 is to require that the effects of temperature on certain allowable stresses be considered where thermal effects are significant under normal operating conditions. Section 27.619 requires that special factors of safety be applied for each part of the structure whose strength is uncertain, likely to deteriorate in service before normal replacement, or subject to appreciable variability because of uncertainties in manufacturing processes or inspection methods. The FAA believes that §§ 27.613 and 27.619 do not specifically provide for the long-term behavior of certain modern construction materials and that the proposals to amend §§ 23.603, 25.603, 27.603, and 29.603 are necessary.

Proposal 7–4. For comments concerning the subject matter of the proposal to amend § 23.605, see Proposal 7–29. The proposal is adopted without substantive change.

Proposal 7–5. No unfavorable comments were received on the proposal to amend § 23.613(c). Accordingly, the proposal is adopted without substantive change.

Proposal 7–6. One commentator objected to the wording of proposed § 23.629(a) which states, "It must be shown by any one of the methods specified in paragraphs (b), (c), or (d) of this section that the airplane is free from flutter * * *". The commentator recommended that proposed § 23.629(a) be revised to clarify that combinations of the methods in proposed §§ 23.629(b), (c), and (d) may be used to show freedom from flutter. The FAA agrees, and the proposal is revised accordingly. The commentator also recommended that proposed § 23.629(a) be revised to clarify that the flutter substantiation requirements of proposed § 23.629 are not applicable to minor structural items such as fairings, lights, and antennas which will not affect safety of flight. The FAA does not agree. The FAA believes that flutter in minor structural items can have an adverse effect upon safety of flight.

One commentator questioned who decides which of the methods specified in paragraphs (b), (c), or (d) are to be applied. The applicant can select any one of the methods specified in paragraphs (b), (c), or (d), or a combination of these methods.

One commentator objected to the requirement in proposed § 23.629(a)(1) that adequate tolerances must be established for quantities which affect flutter, including speed, damping, mass balance, and control system stiffness. The commentator stated that all quantities which affect flutter may not be significant and recommended that proposed § 23.629(a)(1) be reworded to state "those quantities or parameters that would significantly degrade the critical flutter speed are to be considered and pertinent tolerances established where necessary." The FAA believes that all quantities which affect flutter should be considered. However, the use of the word "adequate" indicates that the tolerance to be established will vary, depending on the significance of the quantity considered. Proposed § 23.629(a)(1) is adopted without substantive change.

Two commentators objected to the requirement in proposed § 23.629(a)(2) that natural frequencies of main structural components be determined by vibration tests. It was stated that this proposed change would impose a burden in the case of simple aircraft meeting the requirements of proposed § 23.629(d), and it was recommended that the words "or other approved methods" be reinstated. Upon further review, the FAA believes that the current requirement of "vibration tests or other approved methods" has provided satisfactory results in the past. Proposed § 23.629(a)(2) is revised accordingly.

The FAA believes that the intent of proposed § 23.629(b) may be unclear, since the term "stability" may be applicable either to the structural vibration modes, as intended, or to the airplane itself. The proposal is revised for clarity.

One commentator objected to the wording of proposed § 23.629(c)(1) that "proper and adequate attempts to induce flutter have been made." The commentator stated that this might be interpreted to allow pilot control impulse of the controls and this would not necessarily excite high frequency modes which may exist. The FAA believes that the wording as proposed is adequate. The proposed requirement to develop a vibratory response of the structure during the test will indicate the attempts to induce flutter, and the adequacy of the excitation can be evaluated by reference to the data record. Proposed § 23.629(c) is adopted without substantive change.

One commentator recommended the deletion of proposed § 23.629(d), which allows the use of Airframe and Engineering Report No. 45 in showing the airplane to be free from flutter but submitted no justification for the deletion. Since this report has been used for years with satisfactory results, the FAA believes that this alternative procedure, as revised and set forth in proposed § 23.629(d), should be continued.

One commentator recommended that proposed § 23.629(d)(3)(iii) be revised to state whether a trim-adjustable stabilizer would qualify as a fixed stabilizer. The FAA does not believe that any revision is necessary. The "degree of fixity" governs whether a trim-adjustable stabilizer can be considered a fixed stabilizer in regard to the use of Report No. 45. Some designs may have a high enough "degree of fixity" to allow treatment as fixed stabilizers, while others do not. Accordingly, § 23.629(d)(3)(iii) is adopted without substantive change.

One commentator objected to the proposed § 23.629(f) which would require that the airplane be free from flutter, control reversal, and divergence after the failure of any single element in the primary control system, any tab control system, or any flutter damper. The commentator stated that this requirement would add weight and cost, particularly in light single engine aircraft, since it would require that virtually all primary control systems, tab control systems, and flutter dampers be made fail-safe. The FAA believes this comment has merit, and proposed paragraph (f) is revised to require that airplanes that meet the criteria of paragraphs (d)(1) through (d)(3) of § 23.629 need to be shown to be free from flutter, control reversal, and divergence with a failure of any single element in the tab control system only. The FAA believes that the requirements of Report No. 45 satisfactorily consider the failure of any single element in the primary flight control system, and flutter dampers are not appropriate for airplanes designed to the requirements of Report No. 45. Further, tab control systems, which have been a significant cause of flutter problems, can be designed to prevent flutter after the failure of any single element by balancing or by structural fail-safe means with a minimum cost and weight increase. The FAA further believes that, for airplanes having a configuration or operating speed that does not meet the criteria of paragraphs (d)(1), (2), and (3), the requirement for considering single element failures should be applied to the primary flight control system, any tab control system, and any flutter damper. The FAA believes that for current complex, high-speed designs, the proposed flutter requirements can be met with minimum cost and effects by use of the current state-of-the-art methods of balancing and structural fail-safe features.

One commentator agreed in principle with the proposal to revise § 23.629, but stated that suitable methods of compliance should be specified. The FAA does not believe the rule needs further change but will consider the issuance of guidance material as to applicable means of compliance.

Proposal 7-7. One commentator objected to the proposed amendment to § 23.677 concerning an aural warning device for certain longitudinal trim systems. The device would provide an aural warning when the horizontal stabilizer trim is in transit due to trim system operation or when the power or thrust controls are advanced to the takeoff position with the stabilizer trim set in a position outside the approved range for takeoff. The commentator stated that the warning would tend to be ignored in a cockpit environment which already contains many aural warnings. The commentator also objected to the cost and complexity that this requirement would add. The FAA agrees, and the proposal to add a new § 23.677(d) is withdrawn.

Proposal 7-8. No unfavorable comments were received on the proposal to amend § 23.701. However, after further review, the FAA believes that the proposed change is not appropriate and is not needed for Part 23 airplanes. The proposal is withdrawn.

Proposal 7-9. No unfavorable comments were received on the proposal to amend § 23.723(a) which would allow the use of analysis to supplement tests to substantiate landing load factors. However, the FAA has revised the proposal based on comments received on Proposal 7-34. See Proposal 7-34.

Proposal 7-10. Two commentators questioned the benefit of the ski shock absorption test in proposed §§ 23.737 and 25.737. The commentators noted that the conditions which may cause ski failure in service do not correspond to the conditions of the proposed shock absorption test. Based upon these comments and upon further review within the FAA, the FAA believes that it does not have enough information at this time to specify requirements for ski shock absorption tests and the proposals are withdrawn.

Proposal 7-11. No unfavorable comments were received on the proposal to add a new § 23.785(h). Accordingly, the proposal is adopted without substantive change. The proposal as adopted is redesignated as § 23.785(l) in view of the adoption of §§ 23.785(h), (i), (j), and (k) by Amendment 23-19 (42 FR 30601; June 16, 1977).

Proposal 7-12. No unfavorable comments were received on the proposal to add a new § 23.853(e). However, to ensure consistent interpretation, the applicable portions of Appendix F to Part 25 are set forth in a new Appendix F to Part 23, and the corresponding reference in the proposal is revised accordingly.

In addition, the FAA believes that the proposed requirement for a vertical self-extinguishing test may be unduly restrictive for electrical wire and cable insulation and for certain small parts. An exception is therefore provided for these items.

Proposal 7-13. One commentator agreed with the intent of the proposal to add a new § 23.863, but stated that without appropriate explanatory material, the proposed rule could be applied in a manner beyond the limits of cost and engineering practicality for many general aviation airplanes. The FAA will consider the issuance of appropriate guidance material. The proposal is adopted without substantive change.

Proposal 7-14. No unfavorable comments were received on the proposal to revise § 23.1307(a). However, a commentator suggested that a provision be added to allow the type design to include a seat or other facility (such as a stretcher) that is intended to be occupied on takeoff, during flight and on landing. The FAA believes that Part 23 airplanes utilized for a special purpose should be allowed to have installed berths, such as those approved under § 23.785, as well as approved seats. Proposed § 23.1307(a) is revised accordingly.

Proposals 5-7, 5-24, 5-41, 5-58, 2-84, 2-129, and 2-184. Proposal 5-7 of Airworthiness Review Notice No. 5 (Notice 75-23), to amend § 23.1329 is similar to proposals to amend §§ 25.1329 and 29.1329 and to the proposal to add a new § 27.1311 (Proposals 5-24, 5-58, and 5-41, respectively). Other related proposals affecting §§ 25.1329, 27.1329, and 29.1329 were included in Airworthiness Review Notice No. 2 (Notice 75-10) as Proposals 2-84, 2-129, and 2-184, respectively, and their disposition was deferred for consideration with Proposals 5-24, 5-41, and 5-58, respectively.

Several commentators objected to the above proposals. After consideration of the comments received, and after further review, the FAA believes that except for proposed §§ 23.1311(h) and 25.1329(h) of Proposals 5-7 and 5-24 respectively, which are discussed below, Proposals 2-84, 2-129, 2-184, 5-41, and 5-58 and the remainder of Proposals 5-7 and 5-24 are premature, and they are withdrawn.

One commentator objected to the language "means independent of the mode selector switch" in proposed § 23.1311(h) on the ground that it would require separation of the mode selector from the mode indicator, constituting an unnecessary and burdensome restriction for single and two-axis automatic pilot systems. The FAA believes, after further consideration, that the need to provide reliable mode selection information to the pilot exists only when the automatic pilot system can be coupled to airborne navigation equipment such as VOR and ILS (localizer and glide slope). Accordingly, the proposal is revised to incorporate that qualification.

Several commentators stated that the proposed requirement attempts to provide design details instead of stating the intent, which tends to retard advances in technology, and that it does not take into account modern panels which incorporate illuminated mode indications that give positive indication of the selected mode but are not "independent" of the mode selector switch. The FAA agrees that the proposed requirement is unnecessarily restrictive, and the proposals are revised to specify that selector switch position is not acceptable as a means of indication instead of requiring the means of indication to be independent of the selector switch.

Commentators objected to the phrase "and the availability status of each alternative system" in proposed §§ 23.1311(h) and 25.1329(h), contending that compliance may not be possible for some systems, and that even when possible, the added complexity would reduce reliability and create confusion in the cockpit. The FAA agrees, and the phrase is deleted.

One commentator suggested that proposed § 23.1311(h) be revised to require that the mode selector indication for the automatic pilot system differ from that for the flight director system. The FAA does not have sufficient information at the present time to justify imposing such a regulation. This commentator further suggested that when automatic pilot mode selection indication is provided for both pilot and copilot, those indications must agree. This would merely require that both mode selection indications be correct, and the FAA does not believe that the revision suggested by the commentator is necessary.

In view of the withdrawal of the proposals to redesignate § 23.1329 as § 23.1311 and to add a new § 23.1311(g), proposed § 23.1311(h) is redesignated § 23.1329(g) and is adopted with the revisions discussed above. Proposed § 23.1329(h) (Proposal 5-24) is adopted with the revision discussed above for § 23.1311(h).

Proposal 7-15. Several commentators objected to the wording "the highest loads expected in service under any loading condition" in the proposals to revise §§ 23.1413(a), 25.1413(b), 27.1413(a), and 29.1413 which would broaden the rated strength requirements for safety belts and harnesses. The commentators contended that this wording was unreasonable, vague, and would be difficult to administer. The FAA believes that research and development work in the area of full scale dynamic testing of airplanes and mathematical modeling of the man-seat combination is needed to develop a more definitive standard. The proposed revisions of §§ 23.1413(a), 25.1413(b), 27.1413(a), and 29.1413 are withdrawn.

Proposal 7-16. One commentator objected to the proposal to add a new § 23.1416 which would add pneumatic de-icer boot system requirements. The commentator stated that the words "any forseeable" in paragraph (b) are too broad and suggested that the nominal system operating parameters for each component should be used as a basis for establishing a factor of the nominal as design limit. The FAA disagrees that a factor is appropriate but agrees that the criteria should be revised. Accordingly, the words "any foreseeable" in proposed § 23.1416 are deleted and the words "any normal" are inserted in their place. The same commentator objected to the wording of proposed § 23.1416(c) on the ground that it could be interpreted to mean a pressure gauge would be required in the cockpit. The commentator recommended revising paragraph (c) to require that means be provided to indicate to the flight crew that the pneumatic de-icer boot system is receiving adequate pressure during the inflation cycle. The FAA agrees. This revision would make it clear that the use of pressure switches and indicator lights would be allowed in lieu of a pressure gauge. The proposal is revised accordingly.

Proposal 5-18. One commentator objected to the proposal to amend § 23.1545, contending that it would result in an unwarranted economic burden on aircraft owners. The FAA does not agree. The proposed requirement that the airspeed indicator be marked according to indicated airspeed is necessary to provide a more useful airspeed reference for operation of the airplane. In addition, the FAA does not believe that the proposed requirement would result in an appreciable increase in cost to aircraft owners compared to the current requirements.

Another commentator (who concurred with the proposed revision of § 23.1545) stated that the amount of information required on the airspeed indicator is reaching the point where confusion may be a factor, and that the reference to radials and arcs in § 23.1545 apparently prohibits the use of linear (horizontal or vertical) gauges. The FAA recognizes that indicator markings, if excessive, may cause confusion but believes that the proposed marking requirements are well within safe limits. With respect to linear-scale gauges, it is not the intent of the proposal to prohibit their use. The proposal, as well as present § 23.1545, describes marking for circular airspeed indicators since current airspeed indicators are circular. Analogous markings could be devised for linear-scale instruments and approved under airplane type certification equivalent safety provisions. Accordingly, the proposal to amend § 23.1545 is adopted without substantive change.

Proposal 8-22. For a comment related to proposed § 23.1557(f), see Proposal 8-24. The proposal is revised for the reasons discussed in Proposal 8-24.

Proposal 8-23. No unfavorable comments were received on the proposal to delete § 23.1583(i). Accordingly, the proposal is adopted without substantive change.

Proposed 8-24. Proposed §§ 23.1585(e) and (f), together with Proposal 8-23 for § 23.1583, would transfer information concerning the meaning of the zero fuel indication from the operating limitations section to the operating procedures section of the Airplane Flight Manual. One commentator stated that any reference to "fuel remaining" when the fuel quantity indicator reads "zero" invites pilot error or misinterpretation. The FAA does not agree. The reference to "fuel remaining" appears in the current rule, and the FAA does not have any information at this time to indicate that it has resulted in pilot error or misinterpretation. However, after further review, the FAA believes that the information that is required to be furnished under proposed § 23.1585(e) should be clarified in view of the fuel gauge calibration requirements set forth in § 23.1337(b)(1).

Accordingly, proposed § 23.1585(e) is revised by adding the language "in level flight" so that the section reads in part "* * * when the fuel quantity indicator reads "zero" in level flight, any fuel remaining in the fuel tank cannot be safely used in flight". Similar revisions are made to proposed §§ 25.1585(d), 27.1585(d), and 29.1585(d). Proposed §§ 23.1585(f), 25.1585(e), 27.1585(e), and 29.1585(e) are adopted without substantive change.

In view of the adoption of new §§ 23.1585(e), 27.1585(c), and (d), and 29.1585(c) and (d) in Airworthiness Review Amendment 6 (43 FR 2302; January 16, 1978), proposed §§ 23.1585(e) and (f), 27.1585(d) and (e), and 29.1585(d) and (e) are redesignated and adopted as §§ 23.1585(f) and (g), 27.1585(e) and (f), and 29.1585(e) and (f), respectively.

Proposal 7-17. The proposed amendment to § 25.305(d) and the proposed new Appendix G to Part 25 (Proposal 7-55) are being deferred until final rule making action is taken with respect to Airworthiness Review Notice No. 8 (Notice 75-31; 40 FR 29410; July 11, 1975).

Proposal 7-18. One commentator suggested that proposed § 25.331(a)(4) be revised to allow the trim system to operate at its maximum rate with normal aerodynamic load instead of requiring the flight test trim conditions specified in § 25.255. The FAA believes that there is insufficient data for rulemaking action to make the suggested revision. Another commentator recommended that proposed § 25.331(a)(4) be revised to exclude the effect of out-of-trim conditions as a consideration for the accelerated pitching conditions of proposed § 25.331(c) but retained for the zero pitching accelelation conditions of proposed § 25.331(c). The FAA disagrees. Out-of-trim conditions may exist in zero pitching acceleration maneuvers as well as in accelerated pitching maneuvers and should be considered in both cases. Section 25.331(a)(4) is amended as proposed.

One commentator suggested that proposed § 25.331(c)(1) be revised to clarify the type of pitching parameter to be considered, and to allow for the optional use of transient rigid body response for airplane loads. The FAA agrees. The use of transient rigid body response will yield conservative, but easier-to-calculate loads. The proposal is revised to allow for the use of transient rigid body response and to clarify the type of pitching parameter to be considered.

The same commentator suggested that proposed § 25.331(c) be revised to state that airplane loads which occur subsequent to the occurrence of maximum positive pitching acceleration need not be considered. The FAA disagrees. The commentator did not submit, and the FAA is not aware of, time-history data that shows that the transient down tail load will always reach its peak value at the same time that the elevator surface reaches its maximum prescribed throw and that the pitching acceleration will also always reach a maximum in the nose-up direction at the same time.

The same commentator further suggested that proposed § 25.331(c)(1) be revised to make the requirements applicable to configurations with conventional trailing-edge elevator controls, and that configurations using an all-movable horizontal stabilizer should be designed to the specified control displacements of current § 23.531(c)(3). The commentator stated that applying the proposed requirements to configurations using an all-movable horizontal stabilizer for primary pitching control results in an entirely different type of loading condition than was originally intended for elevator-controlled airplanes. This results, the commentator stated, from the fact that all-movable stabilizers have much lower rate capabilities than elevators; approximately 6 degrees per second for all-movable stabilizers versus 30 to 40 degrees per second for elevators. The FAA does not have sufficient data to support the distinction suggested by the commentator.

Another commentator objected to combining the requirements for "checked maneuver at speeds between V_A and V_D" and the requirements for "specified control displacement" in proposed § 25.331(c)(2). This commentator stated that he is not aware of any evidence that the present required levels of pitching acceleration have resulted in unsafe designs, and that the design requirement should involve either the use of rational time history analyses or, alternatively, the use of the present acceleration criteria. The proposal to amend § 25.331(c)(2) contains the current requirements except that a rational pitching motion-time profile is required rather than optional. The present acceleration criteria were derived from the behavior of airplanes much older than, and different from, those of current design. The FAA does not have enough information regarding the conservatism these criteria provide for modern designs. However, since the rational time history analysis method does consider the behavior of the modern airplanes, that method is specified.

Two commentators stated that proposed § 25.331(c)(2) is not clear with respect to whether pitching accelerations greater than the values quoted in the formula are to be used for design, and also stated that it does not define the control movement to be considered nor state whether the limit load factor must be reached. In addition to proposed § 25.331, the strength criteria contained in other sections of the subpart must be considered in establishing structural design criteria. With respect to control movement and load factor, the FAA does not have any information at this time which would indicate that specific constraints on control movement or load factor are necessary.

The proposal to amend § 25.331 is adopted with the revision discussed above.

Proposal 7–19. Several commentators, including the initial public proponent, objected to the proposal to add a new § 25.341(d) to require the empennage to be designed for gusts which are not purely vertical or lateral in direction. The commentators referred to existing conservatisms in the rules which have resulted in satisfactory service experience to date, and stated the need for further review and evaluation. The FAA, upon further review, believes that there is insufficient data to substantiate the need for the additional requirement at this time. The proposal to add a new § 25.341(d) is withdrawn.

Proposal 7–20. One commentator objected to deletion of the words "as speed brakes" in the proposal to amend § 25.345(c). The commentator stated that the removal of the words "as speed brakes" would increase structural weight, not only in the flaps, but also in the wings and horizontal tail. The FAA agrees that airplane loads, and weight, may increase as a result of this proposed amendment. However, the FAA believes that an airplane should be designed for any condition in which the airplane is normally operated. Airplanes are now commonly flown in en route conditions with flaps deployed for purposes other than as speed brakes, and the airplane structure should be designed for the appropriate loads regardless of the operational reason. Another commentator objected to the deletion of the words "as speed brakes" on the ground that removal would leave unanswered questions on flaps up-down cycling, gust encounters, upsets, and overspeed. The FAA does not have any information at this time which indicates that additional requirements related to these factors are necessary. The amendment to § 25.345(c), is adopted as proposed.

Two commentators suggested rewording the proposed new § 25.345(d) by replacing the word "landing" with the word "maneuvering" to make it clear that the proposed requirement is not intended as an additional landing condition to be investigated under § 25.473. The FAA believes that the suggested rewording would lead to a possible misunderstanding due to altitude effects which may result in a more severe load being applied to the airplane. The intent of the proposal is to provide an additional landing condition to be investigated, but not under § 25.473, at maximum takeoff weight with a maneuvering load factor of 1.5g and the flaps and similar high lift devices in the landing configuration. Accordingly, the proposed new § 25.345(d) is adopted without substantive change.

Proposal 7-21. Several commentators stated that the proposal for § 25.351(a), which would extend the upper limit of the speed range specified in current § 25.351(a) from V_A to V_D, is unduly severe and recommended that the pilot's maximum rudder pedal force be 300 pounds from V_{MC} to V_A and 200 pounds from V_C/M_C to V_D/M_D with linear variation between V_A and V_C/M_C. In addition, one commentator stated that the proposed extension of the upper limit of the speed range would penalize aircraft utilizing manual control systems. The commentator further stated that reducing rudder control force at the higher speeds would be consistent with probable operational practice. The FAA believes that the capability of current jet transports for high rudder forces throughout the design envelope has resulted in a high degree of structural integrity during recovery maneuvers, and that this capability must be ensured in future designs. The proposal to amend § 25.351(a) is adopted without substantive change.

Proposal 7-22. Two commentators expressed a need for clarification of the terms "sudden engine stoppage" as used in the proposal to amend § 25.361(b) and "torque for maximum continuous take-off power" as used in the proposed lead-in of § 25.361(c). Actually the word "take-off" did not appear in Notice 75-26. However, since both terms occur in the current rule and were used in the same sense in the proposal, the FAA does not believe further clarification is needed. Accordingly, the proposal is adopted without substantive change.

Proposal 7-23. All of the comments received in response to proposed § 25.491 either questioned the definition of the words "roughest runway and taxiway profiles to be expected in normal operations", or questioned the means of showing compliance. Two commentators stated that the costs of conducting dynamic analyses are high and that the proposal would cause an unjustified economic penalty by requiring dynamic analyses whether needed for a particular configuration or not. The FAA agrees that a more specified proposal is needed. The proposal to revise § 25.491 is withdrawn.

Proposal 7-24. Although no unfavorable comments were received on the proposed new § 25.499(e), two commentators stated that some factor above the nominal values of torque and static reaction is needed to cover possible increases of loads. The FAA does not believe at this time that a factor for nose gear loads due to steering is needed. Accordingly, the proposal is adopted without substantive change.

Proposal 7-25. One commentator objected to the 1.5g rearward ultimate inertia force requirement of the proposed § 25.561(b)(3)(v) because of inadequate substantiation. The commentator stated that the current research on crashworthiness should be completed before the proposal is finalized. After consideration of this comment, and after further review, the FAA agrees that the proposal to add a new § 25.561(b)(3)(v) is premature, and it is withdrawn.

After consideration of the comments received on the proposal to add a new § 25.561(d) concerning structural crashworthiness requirements for certain multi-deck airplanes, and after further review, the FAA believes that it does not have enough information to set forth a rule of general applicability at this time. Accordingly, the proposal to add a new § 25.561(d) is withdrawn.

Proposal 7-26. After consideration of the comments received on the proposal to add a new § 25.563(b), concerning structural ditching requirements for certain multi-deck airplanes, and after further review, the FAA believes that it does not now have enough information to set forth a general standard which would be appropriate for both partial and full multi-deck configurations. The proposal to add a new § 25.563(b) is withdrawn.

Proposal 7-27. The proposal to revise § 25.571(c)(1), concerning fatigue requirements, is withdrawn in view of the separate rulemaking action that has been initiated to consider the fatigue requirements for transport category airplanes (see Notice 77-15; 42 FR 41236; Aug. 15, 1977).

Proposal 7-28. For comments related to the proposal to add a new § 25.603(c), see Proposal 7-3.

Proposal 7-29. One commentator objected to the proposed amendment to § 25.605(b) which would require that new aircraft fabrication methods be substantiated by a test program. The commentator stated that, to meet current § 25.605, manufacturers presently conduct many tests before new fabrication methods are used, especially where the airworthiness of the airplane is involved. The commentator felt that the present regulations are adequate and questioned the need for a test program requirement since this would require specific FAA approval of the test program. Such approval, the commentator stated, would only increase the expense and require additional time to coordinate. The FAA does not agree that current § 25.605 is adequate. Current § 25.605 requires only that the processes requiring close control to produce a consistently sound structure be performed under an approved process specification. The FAA believes that the proposed rule is necessary to ensure that all new aircraft fabrication methods are tested to determine their soundness. In addition, the manufacturers who currently perform an adequate test program should have no difficulty in meeting the proposed requirement. The proposal to amend § 25.605 is adopted without substantive change.

Proposal 7-30. No unfavorable comments were received on the proposal to amend § 25.613(e). Accordingly, the proposal is adopted without substantive change.

Proposal 7-31. One commentator recommended that the proposed amendment to § 25.629(d)(1)(ii) be revised to include the words "affecting divergence or flutter". The FAA does not believe the change is needed since words to this effect are used in the lead-in of present § 25.629(d)(1).

One commentator objected to the requirement in proposed § 25.629(d)(1)(ii) that freedom from flutter or divergence be shown for any combination of failures not shown to be extremely improbable. The commentator stated that the cost would far outweigh any theoretical improvement to safety over what is presently provided. The FAA disagrees. Service experience has shown that combinations of failures can be expected and, therefore, unless combinations of failures are shown to be extremely improbable, they must be considered in design for freedom from flutter and divergence.

One commentator recommended that the proposed § 25.629(d)(4)(vi) requirement for consideration of any single failure in any flutter damper system be revised to exclude active control systems for damping and apply only to flutter dampers connected to a control surface. The FAA disagrees. Failures in all flutter damping systems must be considered if the freedom-from-flutter requirement of § 25.629(d)(1) is to be demonstrated. The proposal is adopted without substantive change.

Proposal 7-32. One commentator on the proposed amendment to § 25.697(b), concerning lift and drag device controls, recommended that the word "inadvertent" in both sentences of the proposal be replaced with the word "unintentional" or "unintended". The FAA does not believe that a clarification would result from the recommended revision. The proposal is adopted without substantive change.

Proposal 7-33. One commentator objected to proposed § 25.701(a) which would provide for the use of equally reliable means instead of a mechanical interconnection for the synchronization of flaps on opposite sides of an airplane. The commentator questioned what would be as reliable as mechanical interconnection. The FAA believes that there are devices which are available or may become available that are at least as reliable as a mechanical system in this application and would be acceptable alternatives. However, to clarify the intent of the proposed rule, the proposal is revised to read "approved equivalent means" instead of "equally reliable means".

Proposal 7-34. One commentator recommended that proposed § 25.723(a) be revised to state that the analysis which may be used to substantiate landing gear limit load factors for increases in takeoff and landing weights must be based on identical landing gear systems. The commentator expressed the opinion that the use of the word "similar" might cause confusion and allow deviations from the original intent that the analysis must be based on landing gear tests conducted on a landing gear system with identical, not similar, energy absorption characteristics. The FAA agrees, and the proposal is revised accordingly.

Proposal 7-35. For a discussion of the withdrawal of proposed § 25.737, see proposal 7-10.

Proposal 7-36. One commentator opposed the proposal to add a new § 25.773(d) to add markers or other guides to enable pilots to position themselves for optimum outside visibility and instrument scan. The commentator stated that he knew of no airplane that has a position for maximum outside visibility that coincides with optimum eye position for instrument scan. Another commentator concurred with the proposal but recommended that it be revised to clarify that the optimum "combination" of outside visibility and instrument scan is sought. The FAA agrees that what is intended is an optimum combination, and proposed new § 25.773(d) is revised accordingly.

Proposal 7-37. No unfavorable comments were received on the proposal to amend § 25.777. Accordingly, the proposal is adopted without substantive change.

Proposal 7-38. Several commentators objected to the requirements of proposed new § 25.789(b) that would require each major galley component, including serving carts, drawers, and compartments, to have a placard indicating its maximum load. The commentators stated that drawers and compartments are designed for weights that can reasonably be expected in service. Two commentators stated that placarding galley components would not increase the level of safety for the occupants of the airplane, and would not guarantee adherence to the indicated maximum load during operation. Based on these comments, and upon further review within the FAA, the proposed new § 25.789(b) is withdrawn.

No unfavorable comments were received on proposed new § 25.789(c). Accordingly, the proposal is adopted without substantive change and redesignated as § 25.789(b).

Proposals 7-39 and 7-79. Numerous commentators objected to Proposal 7-39 to add a new § 25.802 to establish standards for evacuation alarm systems, and to Proposal 7-79 to add a new § 121.292 to require that evacuation alarm systems be installed on all passenger-carrying airplanes. After considering the comments received, and after further review, the FAA believes that rulemaking on the subject of evacuation alarm systems in passenger-carrying airplanes is premature. Accordingly, the proposals to add new §§ 25.802 and 121.292 are withdrawn.

Proposal 7-40. Proposed § 25.803(c) would replace the present emergency evacuation demonstration conditions with conditions which satisfy both Part 25 and Part 121, thus providing for one demonstration that serves both airworthiness and operational requirements. One commentator stated that the aircraft manufacturer should not be the sole demonstrator of emergency evacuations and recommended that more than one demonstration be required to rule out a "long shot" success. The commentator did not present any data to show that additional demonstrations by persons other than the manufacturer are needed. The FAA believes that demonstrations made under the prescribed conditions and using the prescribed procedures will yield comparable results, and that the manufacturer is competent to conduct such demonstrations.

Two commentators objected to proposed § 25.803(c)(4) which would require that the airplane's normal electrical power sources be de-energized and stated that the existing wording "using only the emergency lighting system" is preferred. The FAA agrees and § 25.803(c)(4) is revised to state that only the airplane's emergency lighting system may provide illumination, except as noted in paragraph (c)(1).

No unfavorable comments were received on proposal § 25.803(c)(5), to require that all emergency equipment must be installed in accordance with §§ 25.1411 and 25.1415. However, the FAA believes that the proposal may be misconstrued, since certain operating rules of the chapter also state emergency equipment installation requirements. Proposed § 23.803(c)(5) is revised to specify that all emergency equipment that is required for the planned operation of the airplane must be installed.

A statement of required crewmember qualifications was inadvertently omitted from proposal § 25.803(c). Present Part 121 App. D paragraph (a)(12) states a requirement for a regularly scheduled line crew, and present § 25.803(c)(6) states a requirement merely for persons who have knowledge of the exits and emergency equipment. The FAA believes that the training and knowledge levels associated with a regularly scheduled line crew are appropriate for any demonstration that is conducted for the introduction of a type and model of airplane into passenger-carrying operations, whether the demonstration is conducted for compliance with Part 121 alone or for dual compliance with Parts 25 and 121. Accordingly, the crew requirements of present Part 121 App. D paragraph (a)(12) are set forth as new § 25.803(c)(7)(i). The crew requirements of present § 25.803(c)(6) have been shown adequate for airplane type certification under Part 25. These requirements are set forth in a new § 25.803(c)(7)(ii) to provide for situations where separate demonstrations of compliance with type certification and operating rules may be necessary or appropriate.

One commentator suggested deletion of the requirements of §§ 25.803(c)(7)(ii) and (c)(7)(iii) requiring at least 5 percent of passengers be over the age of 60 and 5–10 percent be children under the age of 12 years. The FAA believes that age distribution should be considered in the selection of test subjects, and that the proposed requirements are realistic in terms of the age distribution of airline passengers. The proposed §§ 25.803(c)(7)(ii) and (c)(7)(iii) are adopted without substantive change. One commentator requested that, due to laws governing employment and insurance for persons under 18 years of age, § 25.803(c)(7)(iii) be modified to provide an equivalency by adding the words "or at least 5 percent, but not more than 10 percent must be adults between the ages of 50 to 60 years of age." A second commentator suggested essentially the same wording, citing data showing comparable evacuation times for persons under 12 and in the 50 to 59 age group and relating one instance where this equivalency was allowed during evacuation testing. The FAA does not now have enough information on evacuation times for the various age groups to revise the proposal in the manner suggested by these commentators. One commentator recommended that proposed § 25.803(c)(7)(iv) be modified to require the three life-size dolls to have height and weight equivalent to a child. The FAA believes the terms "life-size" and "simulate live infants" adequately express this intent. The proposed § 25.803(c)(7)(iv) is adopted without substantive change.

One commentator stated that reference to the words "crewmembers, mechanics, and training personnel" in § 25.803(c)(7)(v) is only appropriate if tests are being conducted by the operator rather than the manufacturer. The FAA disagrees since such training personnel are also employed by the manufacturer. Accordingly, § 25.803(c)(7)(v) is adopted as proposed.

One commentator suggested that the carry-on baggage, blanket, and pillow requirements of § 25.803(c)(10) be deleted since there would be a reduced risk of injury during the test without significant effect on the results. The FAA does not agree since such items are intended to help simulate actual emergency evacuation conditions and might significantly affect the results of an evacuation test. Proposed § 25.803(c)(10) is adopted without substantive change.

One commentator suggested that § 25.803(c)(12) should state that no "prior" indication may be given of the exits to be used and that the word "advised" is more appropriate in § 25.803(c)(14) than the word "warned". The FAA agrees with both clarifications and the amendments are revised accordingly.

Although no adverse comments were received on the proposed requirements for multi-deck airplanes in § 25.803(c)(16), the FAA believes that it does not now have enough information to establish comprehensive evacuation criteria for multi-deck airplanes and the multi-deck requirements of § 25.803(c)(16) are deleted.

One commentator objected to the requirement in proposed § 25.803(c)(18) that all the emergency equipment that is normally available, including slides, ropes, lights, and megaphones, must be fully utilized during the demonstration. The commentator stated that the utilization of ropes and megaphones places an undue and unrealistic burden on the evacuation demonstration. The commentator believes that the use of ropes at overwing exits introduces the hazard of tripping and entanglement, and could result in a reduced evacuation flow rate, and that the use of megaphones limits the ability of the flight attendant to effect rapid egress of participants by denying the use of one hand and by restricting the line of vision. The commentator also objected that the use of two or more megaphones simultaneously during the demonstration could confuse and misdirect evacuees. The FAA recognizes that certain items of emergency equipment are installed for purposes other than evacuating occupants from an airplane after an aborted takeoff and that a need to control the use of communications devices may exist. These factors should be considered in each applicant's approved procedures. Proposed § 25.803(c)(18) is amended to state that the applicant's approved procedures must be fully used during the demonstration.

Several commentators objected to the proposed amendment to § 25.803(d) which would allow analysis in showing that the airplane is capable of being evacuated within 90 seconds. One commentator stated that analysis alone is an incomplete means of showing compliance and should not be allowed. Another commentator stated that extrapolations based on analytical testing have no practical relation to actual conditions which occur in accidents and in evacuation demonstrations. The FAA agrees that the limitations on the use of analytical procedures should be made clear. The requirement that the Administrator find the analysis data acceptable was intended to preclude approvals which might be based on insufficient test data, such as in the case of a completely new airplane model or a model which has major changes or a considerably larger passenger capacity than a previously approved model.

Accordingly, § 25.803(d) is revised to clarify the intent.

No unfavorable comments were received regarding proposed §§ 25.803(c)(1), (c)(2), (c)(3), (c)(6), (c)(7)(i), (c)(8), (c)(9), (c)(11), (c)(13), (c)(15), and (c)(17). Accordingly, these proposals are adopted without substantive change.

It should be noted that the deletion of several proposed paragraphs and the insertion of a new § 25.803(c)(7) has required the redesignation of the adopted paragraphs.

The proposal to revise §§ 25.803(c) and (d) is adopted with the changes discussed above.

Proposal 7–41. One commentator objected to the proposal to revise § 25.807(a)(7)(vi), stating that a flight attendant seat can be so mounted relative to an exit or to other seats that the flight attendant's access to the exit itself is restricted. The commentator recommended that the proposal be revised to specify that forward facing seats be placed aft of the emergency exit, and aft-facing seats be placed forward of the emergency exit, so that no flight attendant is seated with the attendant's back to the exit. The intent of the proposals to revise § 25.807(a)(7)(vi) is to specify that the seat required by present § 25.807(a)(7)(vi) must be a flight attendant seat which complies with the requirements of §§ 25.785(h) and (i). The FAA is not aware of any unsatisfactory service history with respect to the orientation of seats provided in accordance with present § 25.807(a)(7)(vi), and the commentator did not provide any information which would indicate that a problem exists. The FAA believes that revising the proposal in the manner suggested by the commentator would unduly restrict design. Accordingly, the proposal is adopted without substantive change.

Proposed § 25.807(c)(7) is based on the existing special conditions developed for the current wide body jet airplanes. Based on the comments received, and upon further review within the FAA, the FAA believes that it does not have enough information to adopt a rule of general applicability to multi-deck airplanes at this time. Proposed § 25.807(c)(7) is withdrawn.

Proposal 7–42. Several commentators objected to proposed new § 25.809(f)(1)(iv) which would require that the emergency exit means to assist the occupants in descending to the ground be usable without outside assistance in 25-knot winds. One commentator stated that the proposed section was not clear with respect to whether deployment into a 25-knot wind was required in addition to operation in 25-knot winds after deployment. Proposed § 25.809(f)(1)(iv) is revised to state the requirement more clearly. Another commentator proposed that the weight of one person on the device be allowed to ground it to make it usable. The FAA agrees that the assistance of one person should be allowed. Proposed § 25.809(f)(1)(iv) is revised accordingly. In response to another comment questioning the state-of-the-art, the FAA believes that the proposed requirement, as revised to allow the assistance of one person after deployment, is within the state-of-the-art.

Another commentator stated that the provision concerning wind force direction in proposed § 25.809(f)(1)(iv) was vague. The FAA disagrees since the critical wind direction may vary for each assisting means and the applicant must demonstrate which direction is most critical.

Several commentators objected to the 98 percent reliability requirement in proposed new § 25.809(f)(1)(v) as being difficult to interpret given a relatively small sample size and indicated that tests conducted on new designs may not adequately represent the reliability level in service. Another commentator stated that the reliability requirements in proposed § 25.809(f)(1)(v) were excessive and unwarranted. The FAA believes that the evaluation of slide designs during airplane type certification does establish a level of in-service performance if the slides are maintained properly. The FAA agrees, however, that the amount of testing that would be required to obtain data for the proposed determination of 98 percent reliability may be excessive for the systems under consideration. A more direct testing method, requiring fewer tests, has been found to provide an acceptable measure of egress system reliability in recent airplane type certifications. Proposed § 25.809(f)(1)(v) is revised to specify the use of that method.

One commentator asked how the inertial forces specified in proposed § 25.809(f)(1)(v) would be applied. In practice, this has been done by applying equivalent static loads. (Clearly, test methods will have to be developed for dynamic testing if future designs indicate a need for it.) This commentator also asked whether the last sentence of proposed § 25.809(f)(1)(v) is necessary. The FAA believes that with the test method specified, the testing series must be restarted following failure to ensure that the reliability assessment is valid. The last sentence of § 25.809(f)(1)(v) has been rewritten to make this clear.

Proposal 7–43. One commentator objected to proposed § 25.811(e), stating that the present operating instructions have historically proven adequate to open doors and that there is no need for the additional requirements. The FAA does not agree and believes that the need for the proposed requirements has been established by recent adverse service experience.

One commentator questioned whether proposed § 25.811(e)(2) is applicable to Type II exits. The FAA is unaware of any need for extending this requirement to Type II exits at this time. Consistent with the proposal, the requirement applies only to Type A and Type I exits.

One commentator recommended that proposed §§ 25.811(e)(2)(i), (e)(2)(ii), and (e)(3) be revised to require that a minimum brightness remain after a substantial amount of weathering in service. The FAA believes that a requirement for a minimum brightness belongs in the operating rules and that it is correctly stated in § 121.310(e)(2) of the Federal Aviation Regulations.

Another commentator suggested that the alternative requirements for Type I and Type A passenger exit operating handles set forth in proposed § 25.811(e)(2)(i) and (ii) be made applicable to Type III exit operating handles. The FAA does not agree. The alternative provisions referred to are allowed for Type I and Type A exits because a specified level of illumination must be provided at these exits. However, since illumination levels are not specified for all Type III exit installations, a self-illuminated operating handle must be provided.

One commentator objected to the proposed ±0.5-inch tolerance for the location of the projected point of the arrow for rotary handle markings. The commentator indicated that current door rigging variations cannot always meet the proposed tolerance. The FAA agrees. To allow for rigging variations, proposed § 25.811(e)(4)(ii) is revised to require that centerline of the exit handle be within ±1-inch of the projected point of the arrow when the handle has reached full travel and has released the locking mechanism.

One comment on proposed § 25.811(e)(4)(ii) suggested that no marking is a substitute for having a door mechanism designed so that it is unmistakable when full travel of the mechanism has been reached. It is not clear what the commentator is recommending. However, the proposal requires marking of the handle position at the full travel limit, after the locking mechanism has been released. Since persons unfamiliar with the mechanism may be required to operate it in an emergency, the marking is needed to ensure that they move the handle to full travel against any resistance which may be felt.

Proposed § 25.811(e) is adopted with the revision discussed above. In addition, several nonsubstantive changes have been made for clarity.

Proposal 7–44. No unfavorable comments were received on the proposal to amend § 25.812(e). Accordingly, the proposal is adopted without substantive change.

Two commentators questioned proposed §§ 25.812(f) and (g) to provide emergency lighting coverage with the airplane in abnormal attitudes. One of the commentators contended that present standards have historically provided satisfactory lighting and that a "battery of lights" would be necessary to comply with the proposal. Based on the comments received, and after further review within the FAA, the proposed changes to §§ 25.812(f) and (g) are withdrawn.

Several commentators objected to the proposal to add a new § 25.812(l). One commentator stated that the meaning of "high intensity" is subject to broad interpretation and that a flashlight could provide an acceptable level of illumination. Current § 121.549 (b) provides for a readily available flashlight for each crewmember, and the FAA believes that the intent of the proposal can be met by specifying an accessible flashlight storage means. The proposal to add a new § 25.812(l) is withdrawn and Proposal 7-81 for § 121.301(l) is revised to require flashlight stowage provisions that are readily accessible from each flight attendant seat and to allow 2 years for compliance.

Proposal 7-45. One commentator objected to the proposal to revise § 25.813(c)(1) to add a requirement that "there must be no interference in opening the exit." The commentator considered this proposal to be interpretive material better suited for Advisory Circular action and stated it was not clear. The FAA disagrees. Many emergency exits need more clearance than the projected exit opening to prevent interference when opening the exit, and this proposal would make it clear that adequate clearance is required. The commentator suggested adding after the word "protrusions" the words "to prevent exit door ready removal" in § 25.813(c)(1). The FAA does not believe proposed § 25.813(c)(1) needs clarification, and the suggested wording could lead to misinterpretations.

Another commentator recommended that the requirement of § 25.813(c)(1) be applied to airplanes having 9 to 19 passenger seats. The FAA disagrees. Current requirements of § 25.813(c)(2) consider emergency exit access for airplanes having 19 or less passengers. Service experience has shown no need to change the requirements of § 25.813(c)(2).

After consideration of the comments received, and after further review, the FAA believes that proposed § 25.813(g) to establish material and systems requirements and proposed §§ 25.813(h) and (i) to establish passageway design requirements are premature, and they are withdrawn.

Proposal 7-46. In view of the amendment of § 25.831 by Airworthiness Review Amendment No. 5 (42 FR 36960; July 18, 1977), the FAA believes that proposed § 25.831(g) is not necessary and it is withdrawn.

Proposal 7-47. No unfavorable comments were received on the proposal to amend § 25.863. One commentator asked for an explanation of the means to show compliance with the proposed requirements of paragraph (d). The areas where flammable fluids or vapors could escape by the leakage of a fluid system must be identified and defined as part of type design data submitted by the applicant for type certification. The proposal is adopted without substantive change.

Proposal 8-43. One commentator contended that proposed § 25.901(d) will be difficult to administer because the term "applicable provisions of this subpart" will not be consistently interpreted. The commentator suggested that the applicable provisions be clearly defined. The FAA does not agree with the commentator and believes the suggested revision is unnecessary. The same wording is used in current § 25.901(b)(1) with respect to propulsion powerplant installations, and has been administered without difficulty.

One commentator suggested that only those auxiliary power units (APU) that are classed as essential power units need to meet the applicable provisions of the subpart. Several other commentators suggested that the applicable provisions should be clearly defined to differentiate between essential and nonessential APU installations. The FAA does not agree with these comments. The FAA believes that appropriate requirements for safety must be applied to all APU installations. No justification has been shown for the operation of a nonessential or a ground operation only APU at a safety level that is different from that which is required for an essential APU.

The proposal is adopted without substantive change.

Proposal 8–46 and 3–35. Disposition of Proposal 3–35 to amend § 25.1103 (Notice 75–19) was deferred so that it could be considered in connection with Proposal 8–46. One commentator on Proposal 3–35 suggested that the proposed revision to § 25.1103(d), concerning ducts other than induction system ducts, be placed in a separate section of Part 25. The FAA believes that it is more appropriate to include the requirement in § 25.1103 and to expand the heading of that section to include a reference to air duct systems. Proposal 3–35 is adopted without substantive change. However, § 25.1103(d) as adopted reflects a change proposed by Proposal 8–46. With respect to Proposal 8–46, one commentator suggested that the phrase "unless it can be shown that a duct failure will not result in an additional fire hazard" be added to proposed § 25.1103(b). The FAA does not believe that the suggested condition could be met. The ducts under consideration are those which are contained within fire zones, including the auxiliary power unit fire zone. Duct failures in such areas could allow fire to spread, possibly outside the fire zone, or could reduce the effectiveness of installed fire-extinguishing systems.

Several commentators suggested that it would be difficult to establish the "sufficient distance upstream of the auxiliary power unit compartment" specified in proposed § 25.1103(e). The FAA believes that the proposed standard is appropriate. In this instance, a more definitive standard, taking into account all of the factors that might be involved, would tend to restrict design flexibility unnecessarily.

One commentator objected to proposed § 25.1103(e), contending that its language precluded the use of methods to prevent hot gas reverse flow, which would provide at least an equivalent level of safety. The FAA knows of no practical method other than fireproofing to prevent hot gas reverse flow in induction system ducts. If such a method were developed, the applicant could apply for its approval under the "equivalent safety" provisions of § 21.21(b)(1). This commentator also contended that if proposed § 25.1103(f) is met, it is unrealistic to consider a fire caused by hot gas reverse flow burning in the air induction system. The commentator suggested, instead a requirement to determine the maximum intake duct temperature that could occur under hot gas reverse flow conditions and to use a duct material that can resist these temperatures. The commentator apparently misinterpreted the proposal. Proposed § 25.1103(e) requires that certain portions of each auxiliary power unit induction system duct be fireproof, and proposed § 25.1103(f) states heat tolerance requirements for those portions of the induction system other than those which are specifically required to be fireproof. However, the FAA believes the proposed language may be unclear. Therefore, that portion of § 25.1103(f) which states requirements for the heat tolerance of materials is revised to clarify the applicability and is moved to § 25.1103(e).

Two commentators suggested that proposed § 25.1103(f) be revised to allow the use of materials that may absorb or trap non-hazardous quantities of flammable fluids (or flammable fluids that could present a hazard to the aircraft). These commentators contended that proposed § 25.1103(f) would prevent the use of certain sound suppression materials that trap small quantities of fluids. The FAA agrees and § 25.1103(f) is revised accordingly.

One commentator suggested that an acceptable alternative to compliance with proposed § 25.1103(f) would be to show that any fire which may occur is contained within the induction system. The FAA does not believe that it would be possible to contain a fire in the induction system since the induction system is a passage which is open at both ends.

Substantively identical revisions are made to Proposal 8–73 for § 29.1103.

Proposal 8–47. Two commentators on proposed § 25.1142 stated that there was no need for starting control on the flight deck for auxiliary power units (APU) that are operable only on the ground. The FAA believes that any APU installed on the airplane, whether or not intended only for ground use, should be able to be operated by the flight crew since its improper operation or malfunction could affect the safety of the aircraft. The commentators appear to have interpreted the proposal to apply to both the APUs which are installed in the airplane and to those stationary, portable, or mobile units which are external to the airplane and are considered to be ground support equipment. The proposal is therefore revised to clarify that it is applicable only to installed APUs.

One commentator stated that APU and engine standards in Part 25 should be separated to ensure consistent administration. The FAA does not agree with this commentator, and believes the suggested revision is unnecessary. The APU and engine standards in Part 25 have been administered without difficulty for years.

Another commentator stated that the proposal should be revised to differentiate between essential and non-essential APUs. For a discussion of this comment, see Proposal 8-43.

Proposals 8-49 and 3-41. Disposition of Proposal 3-41 to amend § 25.1195(b) (Notice 75-19) was deferred so that it could be considered in connection with Proposal 8-49. One commentator objected to Proposal 3-41 and suggested that it be revised to read "* * * all extinguishers are not required to crossfeed all engines, but two shots to each engine are required." The proposal deletes the last sentence of present § 25.1195(b) to avoid the possible interpretation that a particular discharge must be directable to every fire zone. Such an arrangement would be acceptable, but individual systems which have a dual discharge capability may be confined to serve a particular fire zone. The proposal is considered equivalent to the wording preferred by this commentator.

Another commentator stated that the proposal does not meet the intent of the explanation unless the last sentence of present § 25.1195(b) is deleted. The proposal includes this deletion. This commentator further stated that the proposed wording contradicts the exemptions allowed by § 25.1195(a). The FAA does not agree. Section 25.1195(b) applies only to non-excepted fire zones. Proposal 3-41 to amend § 25.1195(b) is adopted without substantive change.

One commentator objected to the requirement in Proposal 8-49 for § 25.1195(b) that the test fully simulate actual critical airflow conditions, stating that there should be provisions in the regulations to allow the use of test results and analysis to show compliance. Another commentator objected to the proposal because it does not allow demonstration of compliance by a combination of analysis and analogy with similar engine installations that have been subjected to full scale fire tests. The FAA does not agree with these comments. Distribution of the extinguishing agent within a fire zone is a controlling factor in extinguishing a fire within that fire zone. No acceptable procedure has been found to demonstrate extinguishing agent concentration by analysis, or by reference to tests or service experience on similar powerplant installations, or by reference to tests conducted under conditions other than those encountered in service. Compliance with proposal § 25.1195(b) must be based on actual or simulated flight tests which fully provide the critical airflow conditions to be encountered in flight.

One commentator objected to the words "under critical airflow conditions," "any fire," and "preventing reignition" as meaningless when engine breakup or cowling damage occurs. A second commentator objected to the proposal because no hole size is specified. However, the proposal is based on the assumption that the fire zones under consideration remain intact, with no engine breakup or cowling damage and with only those holes that are present during normal operation. Therefore, no damage factors are specified.

Several commentators objected to the words "and preventing reignition" for the reason that there is no practical way to determine compliance unless the fire and potential reignition sources are defined. These commentators suggested that this requirement should be changed to "and minimize the probability of reignition." The FAA agrees that the language "and preventing reignition" may imply that extinguishing agent concentration must be maintained indefinitely. The FAA believes that this is beyond the present state-of-the-art, and the proposal is revised in the manner suggested by these commentators. Three of these commentators further objected to the proposed requirement for an extinguishing agent concentration capable of "extinguishing any fire" in a fire zone because there is no practical way to determine compliance unless the fire is defined. The FAA agrees, and the proposal is revised to incorporate the words "extinguishing fires" to be consistent with the provisions of present § 25.1195(b).

One commentator stated that the use of full-scale fire tests, evidence of similar powerplant configurations, and analysis were proposed as part of Airworthiness Review Notice No. 8 (Notice 75-19; 40 FR 21866; May 19, 1975) to show compliance with the requirements of §§ 25.1181 through 25.1203, and that this proposal is in conflict with

Notice 75-19. The proposal in Notice 75-19 to which the commentator refers has been adopted as § 25.1207 (Airworthiness Review Amendment No. 4, effective May 2, 1977). Section 25.1207, as adopted, provides for those cases when tests are specifically required. However, in light of the adoption of proposed § 25.1195(b), the FAA believes that § 25.1207 could be confusing and it is revised for clarity. Additionally, this commentator stated that the method of demonstrating satisfactory fire extinguishing capability should be by agreement between the manufacturer and the certificating authority. The FAA does not agree. Objective rules are needed to ensure that a consistent level of safety is maintained.

One commentator stated that the proposal refers to critical airflow conditions while the explanation refers to flight conditions, which are not necessarily the same thing. The FAA agrees that clarification is necessary. The proposal is revised to specify critical airflow conditions in flight.

Proposal 8-49 to amend § 25.1195(b) is adopted with the revisions discussed above. Similar revisions are also made in connection with Proposal 8-75 for § 29.1195(d).

Proposal 7-48. No unfavorable comments were received on the proposal to amend § 25.1307(a). Accordingly, the proposal is adopted without substantive change.

Proposal 5-24. For comments related to the proposal to revise § 25.1329(b), see Proposal 5-7.

Proposal 7-49. One commentator suggested deletion of the words "Such as automatic life raft releases" from proposed § 25.1411(a)(1) since they imply that the requirement is intended to apply only to equipment for ground emergency use. The FAA agrees. This implication is not intended, and the proposal is revised in the manner suggested by this commentator.

Several commentators objected to proposed § 25.1411(a)(2) and to its companion proposal for § 121.309(a)(2) (Proposal 7-80) regarding accessibility of standard emergency equipment to flight attendants. In light of the comments received, and after further review, the FAA believes that it should not be required that safety equipment such as fire extinguishers, portable oxygen bottles, and first aid kits be positioned adjacent to each flight attendant seat and be readily accessible to the seated flight attendant. From a safety standpoint, it is not essential that this equipment be used from a seated position, and from a practical standpoint it would be difficult to provide for the installation of the equipment in the confined areas proposed. Safety equipment should be installed in accessible areas of the aircraft where it would be available during an emergency. However, the FAA believes that when a public address system is provided in compliance with the operating rules of this chapter, the flight attendant seated in any of the seats located adjacent to a floor level exit may be required to use the public address system. Therefore, at least one public address system microphone intended for flight attendant use should be positioned at each floor level exit and be readily accessible to a flight attendant seated in any seat adjacent to the exit. The proposal to amend § 25.1411(a)(2) is revised accordingly. The proposal for § 121.309(a)(2) is revised in a substantively identical manner and is adopted as part of § 121.318(b), which is concerned with public address systems.

One commentator objected to the proposed amendment in § 25.1411(a)(2) that "no equipment may be located as to adversely affect the safety of the flight attendant under any condition," stating that compliance would be clearly impossible to achieve. The FAA agrees that the proposed requirement may be too restrictive and it is deleted.

No unfavorable comments were received on the proposal to add a new § 25.1411(b)(3). The FAA believes that the requirements to identify the contents of storage compartments and containers are adequately covered in § 25.1541(c). The proposal for § 25.1411(b)(3) is withdrawn.

No unfavorable comments were received on the proposal to amend § 25.1411(d) and it is adopted without substantive change.

Two commentators objected to the proposal to add a new § 25.1411(h) which would require that emergency equipment be clearly marked to indicate its method of operation if it is not obvious. The commentator objected to passengers operating emergency equipment without assistance from flight attendants and also pointed out that current § 25.1561 already requires the marking of safety equipment as to its method of operation. After further review, the FAA believes that although crewmembers are not always available, the current marking instructions set forth in § 25.1561 cover passenger use. Proposed new § 25.1411(h) is withdrawn.

Proposal 7–50. The proposal to amend § 25.1413(b) is withdrawn. For comments related to the withdrawal, see Proposal 7–15.

Proposal 7–51. Two commentators objected to the proposal to add a new § 25.1415 (b)(4), which would require that one-half of the non-portable rafts be considered unusable for ditching. The commentators stated that the requirement that one-half of the rafts be considered unusable is unrealistic. The FAA does not agree since a non-portable raft, or a raft which by design cannot be used at other than its primary exit, may not be operable if that exit malfunctions or if ditching conditions are such that that exit cannot be used. However, after consideration of the comments received, and after further review, the FAA believes that it does not have enough information to prescribe a rule of general applicability for the design of ditching provisions which incorporate nonportable rafts. Accordingly, proposed new § 25.1415(b)(4) is withdrawn. The FAA believes that with the withdrawal of proposed § 25.1415(b)(4), the reference to portable rafts that is contained in proposed § 25.1415(b)(3) may be interpreted as allowing the use of nonportable rafts. This effect is not intended, and proposed new § 25.1415(b)(3) is withdrawn.

Several commentators objected to the proposal to add a new § 25.1415(b)(5), which would require that means be provided to assist the airplane's occupants in boarding the rafts from the airplane without entering the water. The commentators contended that for certain sea conditions no means has been demonstrated for boarding rafts from airplanes without the possibility of the occupants entering the water. The FAA agrees and proposed new § 25.1415(b)(5) is withdrawn.

Proposal 7–52. No unfavorable comments were received on the proposal to add a new § 25.1416 which adds pneumatic de-icer systems requirements. However, the FAA has revised the proposal based on the comments received on Proposal 7–16. See Proposal 7–16.

Proposal 7–53. Several commentators recommended revisions to the proposal to add a new § 25.1423 which would establish intercommunication equipment requirements for multideck airplanes. One commentator recommended that the lead-in paragraph be revised to make the requirements applicable to airplanes with adjacent occupiable decks or compartments (excluding lavatories) and that the intercommunication and the two-way alert means be required between each occupiable deck or compartment and the flight deck. The same commentator recommended that the intercommunication system and the two-way alert means be capable of providing crewmembers on all decks or occupiable compartments an immediate indication of an emergency situation on any deck or occupiable compartment (excluding lavatories). In the light of the comments received, and after further review, the FAA believes that it does not now have enough information to specify intercommunication equipment requirements appropriate for all transport category airplanes. The proposal to add a new § 25.1423 is withdrawn.

Proposal 8–57. One commentator suggested that proposed new § 25.1522 be revised so that it would also apply to auxiliary power units (APU) that do not meet the requirements of TSO-C77 (§ 37.183). The FAA does not agree. The proposal recognizes that operating limitations established under a TSO do not have to be reestablished as a part of airplane type certification. However, an airplane type certificate applicant would have to develop appropriate operating limitations during the airplane type certification for any installed APU not manufactured under the provisions of a TSO. Such APU operating limitations would then become part of the aircraft type design. The proposal has no applicability in the situation discussed by the commentator.

Another commentator, while agreeing with the proposal, suggested that proposed § 25.1522 be revised to require also that each APU meet the requirements of TSO-C77. The FAA does not agree. TSO-C77 is applicable only to gas turbine powered APU's.

The suggested revision would require that APU's other than gas turbine units be manufactured to the standards which are appropriate to, and established only for, the manufacture of gas turbine auxiliary power units.

The proposal is adopted without substantive change.

Proposal 7-54. One commentator objected to the proposal to amend § 25.1561(c) which makes clear that the removal of required emergency equipment from the stowage provisions be "easy." The commentator suggested replacement of the word "facilitate" between the words "and" and "removal" with the words "provide easy accessibility and rapid" in § 25.1561(c). The FAA does not believe that the recommended revision is necessary to accomplish the intent of the proposal and the proposal is adopted without substantive change.

Proposal 8-60. No unfavorable comments were received on the proposal to delete § 25.1583(g). Accordingly, the proposal is adopted without substantive change.

Proposal 8-61. For a comment related to the proposal to amend § 25.1585, see Proposal 8-24. Proposed § 25.1585(d) is revised for reasons stated in the discussion of Proposal 8-24. Proposed § 25.1585(e) is adopted without substantive change.

Proposal 7-55. For a discussion of the deferral of the proposal to add a new Appendix G to Part 25, see Proposal 7-17.

Proposal 8-63. No unfavorable comments were received on the proposal to revise § 27.79(b)(2). Accordingly, the proposal is adopted without substantive change.

Proposal 7-56. For comments related to the proposal to add a new § 27.603(c), see Proposal 7-3.

Proposal 7-57. For comments related to the proposal to amend § 27.605, see Proposal 7-29.

Proposal 7-58. One commentator apparently misunderstood the proposed addition to tne lead-in of § 27.613(d). The commentator stated that the proposal did not change the current rule. However, the proposal would add the words "or other values approved by the Administrator," to the lead-in. With this change, the Administrator may allow the applicant greater flexibility in the selection of design values. The proposal is adopted without substantive change.

Proposal 7-59. Several commentators objected to the proposed amendments of §§ 27.671 and 29.671 on the ground that they would require extensive redundancy in the mechanical portion of the flight control system and require that the rotorcraft be capable of continued safe flight and landing if all engines fail. The commentators stressed that no current state-of-the-art designs can meet the proposed requirements and that redundancy may cause less reliable structure as a result of extreme complexity. One commentator stated that adequate safety can be achieved by proper design and fatigue testing and analysis. After consideration of the comments received, and after further review, the FAA believes that it does not have enough information at this time to set forth an appropriate general standard for control system performance following failure or malfunction. The proposed changes to §§ 27.671 and 29.671 are withdrawn.

Proposal 7-60. No unfavorable comments were received on the proposal to revise § 27.675(d)(1). Accordingly, the proposal is adopted without substantive change.

Proposal 7-61. The proposed deletions of §§ 27.695 and 29.695 are related to the proposed revisions of §§ 27.671 and 29.671. In consideration of the withdrawal of the proposed revision of §§ 27.671 and 29.671, the proposed deletions of §§ 27.695 and 29.695 are withdrawn. See Proposal 7-59.

Proposal 7-62. Several commentators objected to the requirement in proposed §§ 27.737 and 29.737 that compliance with shock absorption tests must be demonstrated with ski components installed on rotorcraft. The commentators emphasized that the design of helicopter landing gear, such as standard skid designs, is such that ski installations will not generally change energy absorption characteristics. The FAA agrees. The proposals to amend §§ 27.737 and 29.737 are withdrawn.

Proposal 7-63. Several commentators objected to the proposed amendment to § 27.853 which would impose certain of the compartments interior fire protection requirements for transport category airplanes on normal category rotorcraft. The commentators stated that these proposed requirements are not reasonable for normal category rotorcraft and are more severe and more restrictive than the current requirements for normal category airplanes. The FAA agrees, and the proposal to amend § 27.853 is withdrawn.

Proposal 7-64. Two commentators objected to the proposal to add a new § 27.863 that would require protection from a flammable fluid or vapor fire outside the engine compartment. The commentators stated that the small, unsophisticated fluid carrying systems in normal category rotorcraft make this an unnecessary and expensive compliance item without increasing safety. The FAA disagrees. The agency believes that the smaller and less complex fluid carrying systems will be able to meet this requirement with correspondingly small and simple means. The proposal is adopted without substantive change. Also see the comments for Proposals 7-47 and 7-75.

Proposal 7-65. The proposal to amend § 27.1413(a) is withdrawn. For comments related to the withdrawal, see Proposal 7-15.

Proposal 7-66. Several commentators objected to the proposals to add new §§ 27.1463 and 29.1463 to require a means to prevent persons from inadvertently contacting the tail rotor of a rotorcraft. The comment was made that the only practical way to prevent a person from contacting a tail rotor is to make it physically impossible for the person to reach the tail rotor. This could be accomplished by raising the tail rotor or by using shrouds and screens. On smaller rotorcraft shrouds and screens would have to be used to prevent tail rotor contact by a person since it would be impossible to raise the tail rotor sufficiently. It was contended that providing a shroud and screen of sufficient strength and rigidity to accomplish its purpose, without itself causing a hazard due to deformations to be expected in service, would add excessive weight in a weight critical area of many rotorcraft designs. The FAA agrees with these comments and after further consideration the proposals to add new §§ 27.1463 and 29.1463 are withdrawn.

Proposals 5-51 and 5-65. Two commentators objected to proposed §§ 27.1545(a) and 29.1545(a) on the ground that these provisions are appropriate only to fixed-wing aircraft. Apparently these commentators construed the reference to paragraph (b) in proposed §§ 27.1545(a) and 29.1545(a) as referring to the markings specified in proposed § 23.1545(b). However, the paragraph (b) that is referred to in proposed § 27.1545(a) is current § 27.1545(b), and the paragraph referred to in proposed § 29.1545(a) is current § 29.1545(b). Sections 27.1545(b) and 29.1545(b) have not been changed. Accordingly, the proposals to revise §§ 27.1545(a) and 29.1545(a) are adopted without substantive change.

Proposal 8-65. No unfavorable comments were received on the proposal to delete § 27.1583(f). Accordingly, the proposal is adopted without substantive change.

Proposal 8-66. No unfavorable comments were received on the proposal to amend § 27.1585; however, proposed § 27.1585(d) is revised for reasons stated in the discussion of Proposal 8-24. Proposed § 27.1585(e) is adopted without substantive change. In view of the adoption of new §§ 27.1585(c) and (d) in Airworthiness Review Amendment No. 6 (42 FR 2302; January 16, 1978), proposed §§ 27.1585(d) and (e) are redesignated and adopted as §§ 27.1585(e) and (f), respectively.

Proposal 8-68. In the proposed amendment of § 29.75, one commentator objected to the use of the 50-foot height criterion for the determination of Category A landing distance. The commentator suggested a rewording that was identical to the proposal except that the 50-foot height criterion would be replaced by a requirement that the approach flight path cross the edge of the heliport at an altitude of 25 feet or less. According to the commentator, the 50-foot altitude criterion is inconsistent with past practices of some certification programs and there has been no adverse experience with the use of a 25-foot altitude "window." The FAA does not agree with the commentator. The FAA is aware of only one instance in which a 25-foot height criterion was used. In that instance, a 25-foot height was specified for landing operations to be conducted on a 2,300-foot runway. The FAA is not aware of any certification experience involving the use of a range of altitudes over the edge of the heliport (the "altitude window" concept) in the determination of Category A landing distances.

The commentator also suggested that the Category A performance requirements should be edited as a group and put into language which is understandable to people who work with helicopters. However, the commentator did not make any specific recommendations, and the FAA has no information which would indicate that Category A performance requirements are difficult to understand.

The proposal to amend § 29.75 is adopted without substantive change.

Proposal 7–67. For comments related to the proposal to add a new § 29.603(c), see Proposal 7–3. Section 29.603(c), as adopted, differs from the proposal for the reasons discussed in Proposal 7–3.

Proposal 7–68. For comments concerning the subject matter of the proposal to amend § 29.605, see Proposal 7–29. The proposal is adopted without substantive change.

Proposal 7–69. No unfavorable comments were received on the proposal to amend § 29.613(d). Accordingly, the proposal is adopted without substantive change.

Proposal 7–70. The proposal to amend § 29.671 is withdrawn. For a discussion of the withdrawal, see Proposal 7–59.

Proposal 7–71. No unfavorable comments were received on the proposal to amend § 29.675(d)(1). Accordingly, the proposal is adopted without substantive change.

Proposal 7–72. The proposal to delete § 29.695 is withdrawn. For discussion related to the withdrawal, see Proposal 7–61.

Proposal 7–73. The proposal to amend § 29.737 is withdrawn. For discussion related to the withdrawal, see Proposal 7–62.

Proposal 7–74. Several commentators objected to the proposal to amend § 29.853, which would impose certain of the compartment interior fire protection requirements for transport category rotorcraft. The commentators cited the favorable service experience to date, the smaller cabins of transport category rotorcraft relative to transport category airplanes, the ability of helicopters to land quickly, and the fact that helicopter cabins are not pressurized, as reasons not to impose transport category airplane requirements on transport category rotorcraft. The FAA disagrees. The service experience cited is based on the relatively small current civil fleet of transport category rotorcraft. However, the current fleet is increasing in size both with respect to the number of rotorcraft and with respect to the size of rotorcraft.

In response to another comment, proposed § 29.853(a) has been further revised to set forth the applicable requirements contained in §§ 25.853(a) and (b) rather than cross referencing those regulations.

However, the cross-reference to Appendix F of Part 25 for test procedures has been retained. See also the discussion of Proposal 7–12.

Proposal 7–75. Two commentators objected to the proposal to revise § 29.863 on the ground that the present regulations provide an adequate level of safety without adding unnecessary cost to the certification program. The FAA believes that the proposed requirements are necessary to ensure protection from a flammable fluid or vapor fire. The proposal is adopted without substantive change. Also see the discussion of Proposals 7–47 and 7–64.

Proposal 8–69. No unfavorable comments were received on the proposal to amend § 29.901. For comments related to the like proposal to amend § 25.901, see Proposal 8–43. The proposal is adopted without substantive change.

Proposal 8–70. One commentator objected to the requirements in proposed § 29.923(a) that the tests be conducted on the rotorcraft and that the test torque be absorbed by the actual rotors to be installed. This commentator stated that the testing of larger drive systems while installed on the rotorcraft is impractical and, in some cases, unconservative in view of the manner in which the rotorcraft must be attached to the ground to absorb the powers involved. Another commentator also objected to the requirement that the 200-hour test be conducted on the rotorcraft. This commentator stated that for conventional rotorcraft with anti-torque tail rotors, or those with contra-rotating rotors, the test purpose could be fulfilled by conducting the test on a suitable rig, if it can be demonstrated that the distortion and vibration conditions are the same as those met on the rotorcraft. The requirements to which these commentators objected are contained in present § 29.923 and were merely restated for clarity in the proposal. Further, the FAA believes these requirements are necessary to ensure the validity of the test results.

One commentator suggested that for clarity § 29.923(a) should read "* * * for at least 200 hours plus any extra time required to meet paragraphs (b)(2) and (k) of this section where more than two engines are fitted in the rotorcraft." The FAA believes that the applicability of §§ 29.923(b)(2)(ii) and (k)(2) to multi-engine rotorcraft is clearly stated and that the revision suggested by this commentator is unnecessary.

The proposal to amend § 29.923 is adopted without substantive change.

Proposals 8–71 and 2–164. Disposition of Proposal 2–164 to amend § 29.927 (Notice 75–10, 40 FR 10802; March 7, 1975) was deferred so that it could be considered in connection with Proposal 8–71. One commentator on Proposal 2–164 to amend § 29.927(b)(2) questioned whether due consideration had been given to the 30-minute emergency power rating when establishing the 15-minute time requirement for the torque transmission test. The 30-minute training is substantiated by the endurance testing specified in proposed § 29.923, while the proposed 15-minute time requirement is associated with testing which must be done if turbine engine output can exceed the highest engine or transmission torque limit and that output is not directly controlled by the pilot under normal operating conditions. The highest engine or transmission torque limit is usually associated with takeoff torque, and the 15-minute test would be done at a torque level substantially higher than that associated with the 30-minute rating. The FAA therefore believes that due consideration has been given to the 30-minute ratings, and Proposal 2–164 is adopted without substantive change.

One commentator on Proposal 8–71 agreed with the concept that the overspeed test should be a "proof" test, but questioned the use of maximum continuous speed as a datum. The commentator stated that the use of 120 percent of maximum continuous speed would be acceptable provided this value is at least equal to 105 percent of rotor never-exceed speed and 115 percent of takeoff speed. Maximum continuous speed is used as a reference speed in other required testing of the rotor drive system, and the FAA believes it is appropriate to retain it for consistency. Further, the FAA does not have any information at the present time to indicate that the additional requirements recommended by the commentator are necessary.

One commentator objected to the provisions "After completion of the 200-hour, tie-down test and without intervening major disassembly" in proposed § 29.927(d). The FAA agrees that this provision is inappropriate. The intent of the proposal was to disassociate the overspeed test from the 200-hour, tie-down test since the tests are unrelated. The proposal is revised by striking the words "After completion of the 200-hour, tie-down test and without intervening major disassembly."

Proposal 8–72. No unfavorable comments were received on the proposal to amend § 29.1091 and it is adopted as proposed.

Proposal 8–73. For comment related to the proposal to revise § 29.1103, see Proposal 8–46. The proposal is revised for the reasons discussed in Proposal 8–46.

Proposal 8–74. One commentator objected to the requirement in proposed § 29.1142 that controllability from the flight deck must be provided for auxiliary power units (APU), contending that nonessential APUs should be excluded from the requirement. The FAA does not agree. The commentator has not presented any reason to justify distinguishing between APUs on the basis of the essential or nonessential nature of the services provided by the APU. The FAA believes the flight crew should be provided a means to control an emergency involving any installed auxiliary power unit.

For reasons that are stated in the discussion of Proposal 8–47, proposed § 29.1142 is revised by inserting the word "installed" between the words "each" and "auxiliary."

Proposal 8–75. For comments related to a proposal similar to the proposal for § 29.1195(d), see Proposal 8–49. Section 29.1195(d), as adopted, differs from the proposal for the reasons discussed in Proposal 8–49.

Proposal 7–76. The proposal to amend § 29.1413 is withdrawn. For a discussion of the withdrawal, see Proposal 7–15.

Proposal 7–77. The proposal to add a new § 29.1463 is withdrawn. For a discussion of the withdrawal, see Proposal 7–66.

Proposal 8–76. No unfavorable comments were received on the proposal to add a new § 29.1522. For comments related to the proposal to add a new like section under

Part 25, see Proposal 8–57. The proposal to add new § 29.1522 is adopted without substantive change.

Proposal 5–65. For comments related to the proposal to revise § 29.1545(a), see Proposal 5–51. The proposal is adopted without substantive change.

Proposal 8–78. No unfavorable comments were received on the proposal to delete § 29.1583(g). Accordingly, the proposal is adopted without substantive change.

Proposal 8–79. No unfavorable comments were received on the proposal to amend § 29.1585; however, proposed § 29.1585(d) is revised for reasons stated in the discussion of Proposal 8–24. Proposed § 29.1585(e) is adopted without substantive change. In view of the adoption of new §§ 29.1585(c) and (d) in Airworthiness Review Amendment No. 6 (43 FR 2302; January 16, 1978), proposed §§ 29.1585(d) and (e) are redesignated and adopted as §§ 29.1585(e) and (f), respectively.

Proposal 7–78. One commentator suggested that the proposal to amend § 121.291 be revised to allow an air carrier to utilize the results of an evacuation demonstration conducted by another air carrier to eliminate the need for an additional demonstration. The purpose of the proposed amendment to § 121.291 and the related proposals to revise § 25.803(c) (Proposal 7–40) and to delete paragraph (a) of Appendix D to Part 121 (Proposal 7–84) is to specify conditions for an emergency evacuation demonstration to be conducted during type certification, which meets both airworthiness and operational needs. The FAA does not believe that any further relaxation of the current requirement that a Part 121 operator conduct a demonstration in addition to that conducted during type certification of the airplane, is justified. This commentator also recommended revising the proposal to require a demonstration upon a major change in cabin interior configuration that significantly affects the emergency evacuation duties of crewmembers. The FAA believes that present § 121.291(a)(2) adequately provides for the situation described by the commentator.

One commentator suggested that paragraph (a) of Appendix D to Part 121 be retained since there are certain differences in wording between that paragraph and § 25.803(c) which would be inappropriate. After consideration of this comment, and upon further review, the FAA agrees that paragraph (a) of Appendix D Part 121 contains certain requirements for emergency equipment installation, for seating density and arrangement, and for crewmember qualifications which are appropriate to an emergency evacuation demonstration conducted by an operator and which should be retained. Proposal 7–84 to delete paragraph (a) of Appendix D is withdrawn, and the reference to that paragraph which appears in present § 121.291(a) is retained.

Proposal 7–79. The proposal to add a new § 121.292 is withdrawn. For a discussion of comments related to the proposal, see Proposal 7–39.

Proposal 7–80. For discussion concerning the revision of the proposal for § 121.309 (a)(2), see Proposal 7–49. Since provisions for a public address system and its use are currently provided under § 121.318, the FAA believes that substance of the proposed § 121.309(a)(2), as revised, is more appropriately stated in § 121.318, and that section is revised accordingly. The provision for a delayed effective date has been retained but extended to 2 years.

The proposal to add a new § 121.309(a)(3) is withdrawn since the proposed requirements are adequately covered in § 121.309(b)(4).

While no unfavorable comments were received on the proposal to amend § 121.309 (b)(3), upon further review the FAA believes that the current requirement adequately covers identification and marking of equipment operation. Accordingly, the proposal is withdrawn.

Proposal 7–81. Several commentators objected to the proposal to amend § 121.310(a), which would require that existing aircraft comply with the emergency evacuation slide requirements in proposed § 25.809(f)(1) within 2 years of the effective date of this amendment. The commentators stated that 2 years would not be enough time to develop and test emergency evacuation slides complying with proposed § 25.809(f)(1) and to retrofit them to existing aircraft. One commentator further objected that the design development and testing needed would constitute an undue burden for the operator, and that there is no assurance that the proposed criteria could be applied retroactively to all airplanes. The FAA agrees, and the proposal to amend § 121.310(a) is withdrawn.

One commentator stated that the requirement in proposed new § 121.310(d)(4), that each emergency light have a cockpit control device with "on", "off," and "armed" positions 1 year after the effective date of the amendment, may be too restrictive, particularly for large fleet operators. Upon further consideration, the FAA believes the retrofit requirement should be extended to two years. Proposed new § 121.310(d)(4) is revised accordingly.

For a discussion of the revision to proposed § 121.310(1), see Proposal 7-44.

Proposal 7-82. One commentator objected to the proposal to revise § 121.319(b)(1) to require two-way communication between the pilot compartment and all the galleys and other flight attendant stations on the ground that the proposed requirement would result in unnecessary redundancy and would not be cost effective. The commentator agreed with a requirement for interphones for only those galleys physically isolated from the passenger compartment. Two other commentators stated that adequate communication could be provided without interphones at each flight attendant station and galley because of the close proximity of some flight attendant stations to galleys. Another commentator suggested that the interphone be required only at required flight attendant stations. The FAA agrees that the intent of the proposal can be accomplished without requiring a means of communication to all galleys and other flight attendant stations. Accordingly, the proposal is revised to require a means of two-way communication between the pilot compartment and each galley which is located on other than the main passenger deck level and each passenger compartment.

One commentator stated that the installation of the proposed two-way communication system would require the modification of aircraft and therefore requested a delayed effective date. The FAA agrees and the proposal is revised to provide 2 years for compliance with the new requirement.

Additionally, §§ 121.313(b)(3), (b)(4), and (b)(5) are revised for consistency with the proposal for § 121.319(b)(1) by deleting the words "the passenger compartment" and substituting the words "each passenger compartment" in their place.

Proposal 7-83. One commentator stated that under the proposed rule it is conceivable that an aircraft of 300 passenger capacity might have its raft requirement satisfied with three rafts of 100 person capacity each, and considered such compliance to be impractical from the standpoint of passenger flow, urgency of evacuation at the time of ditching, and the number of exits available to those surviving passengers. The commentator recommended that the minimum number of life rafts be equivalent to the number of exits for launching of life rafts and for exiting of passengers of the ditched aircraft. The FAA does not have sufficient information at the present time to justify requiring more life rafts than would be required by proposed § 121.339(a)(2).

One commentator recommended that the proposal to amend § 121.339(a)(2) be revised to use the wording in § 25.1415(b)(1). The FAA agrees. The proposed amendment to § 121.339(a)(2) was intended to update it to agree with the requirements of § 25.1415(b)(1). The proposal is revised accordingly.

Proposal 7-84. The proposal to delete paragraph (a) of Appendix D to Part 121 is withdrawn. For discussion of the withdrawal, see Proposal 7-78.

ADOPTION OF THE AMENDMENTS

Accordingly, Parts 23, 25, 27, 29, and 121 of the Federal Aviation Regulations (14 CFR Parts 23, 25, 27, 29, and 121), are amended, effective December 1, 1978.

(Secs. 313(a), 601, 603, 604, Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421, 1423, 1424), sec. 6(c), Department of Transportation Act (49 U.S.C. 1655(c)).)

Amendment 27-17

Airworthiness Review Program—Amendment No. 8: Cabin Safety and Flight Attendant Amendments

Adopted: January 29, 1980 **Effective: March 6, 1980**

(Published in 45 FR 7750, February 4, 1980)

SUMMARY: The purpose of these amendments to the Federal Aviation Regulations is to update and improve the airworthiness standards applicable to cabin safety and to those affecting flight attendants. These amendments are part of the Airworthiness Review Program.

FOR FURTHER INFORMATION CONTACT:

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SUPPLEMENTARY INFORMATION: These amendments concern cabin and flight attendant safety and are part of the Airworthiness Review Program. They are based on two Notices of Proposed Rule Making—Notice 75-10 published in the Federal Register on March 7, 1975 (40 FR 10802), and Notice 75-31 published in the Federal Register on July 11, 1975 (40 FR 29410). Because of the Federal Aviation Administration's serious concern for cabin and flight attendant safety, these proposals are being handled separately in this amendment. This action completes disposition of the proposals contained in Notice 75-10; the remainder of the proposals contained in Notice 75-31 will be treated in a subsequent rulemaking action.

The following amendments have previously been issued as part of this Airworthiness Review Program:

Title	*FR citation*
Form Number and Clarifying Revisions....	(40 FR 2576; Jan. 14, 1975).
Rotorcraft Anticollision Light Standards...	(41 FR 5290; Feb. 5, 1976).
Miscellaneous Amendments..............	(41 FR 55454; Dec. 20, 1976).
Powerplant Amendments................	(42 FR 15034; March 17, 1977).
Equipment and Systems Amendments.....	(42 FR 36960; July 18, 1977).
Flight Amendments....................	(43 FR 2302; Jan. 16, 1978).
Airframe Amendments..................	(43 FR 50578; Oct. 30, 1978).

Interested persons have been afforded the opportunity to participate in the making of these amendments and due consideration has been given to all matters presented.

BACKGROUND

In late 1978, the Administrator ordered a review of all cabin safety programs and projects within the various FAA offices. While the agency's several programs all pursued the same goal of improving safety, there was lacking a cohesiveness of effort, a central focal point. After assessing the status of these projects, the Administrator in early 1979, directed the agency to integrate all aspects of cabin safety into one program. The agency's new approach is to comprehensively deal with the problems by relating all aspects of cabin safety into a "total" cabin safety program with one program manager, the Director of Aviation Safety.

The integrated cabin safety program consists of a number of key activities which individually exist at various stages of completion. This amendment, as one element of that program, converts all but one of the proposals concerning cabin safety contained in the outstanding notices of proposed rulemaking, into final rules. The proposal concerning lower deck service compartments, § 25.819 (Proposal 8-40) has been deferred to later rulemaking action.

Other portions of the overall program, which are not dealt with in this action, concern such areas as the smoke, toxicity, and flammability characteristics of cabin interior materials and fuel explosion suppressive devices. These matters are currently the subjects of intensive research and development work which will form the basis of future regulatory standards.

The FAA's concern for improving the cabin safety environment for the traveling public, and for the flight crews and flight attendants serving that public, was underscored by the numerous comments received in response to Notices 75-10 and 75-31. While those notices contained many proposals for rule changes in other important airworthiness certification areas, the widespread concern over cabin safety has prompted the FAA to treat the subject by separate amendment at this time.

The proposals which form the basis for this amendment cover aircraft certification requirements for seats to be occupied by flight crewmembers, flight attendants, and forward observers. Relative to the seats, the proposals also speaks to seat belts and shoulder harnesses. Other items of cabin safety include stowage and service compartments, floor surfaces, and waste receptacles. In addition to the proposals related to type certification requirements, this amendment also completes action on proposals for operating rule changes that will impose some similar requirements on currently operating aircraft.

The FAA has determined that this document involves a proposed regulation which is non-significant under Executive Order 12044 as implemented by DOT Regulatory Policies and Procedures [44 FR 11034; February 26, 1979]. The regulatory evaluation prepared for the regulations is contained in the regulatory docket. A copy of the regulatory evaluation may be obtained by contacting the person identified above under the caption "FOR FURTHER INFORMATION CONTACT. . ."

DISCUSSION OF COMMENTS

The following discussion is keyed to like-numbered proposals contained in Notice 75-31. Proposals from Notice 75-10 are identified and discussed with the related Notice 75-31 proposals.

Proposals 8-36 and 2-60. In addition to the proposed revision of § 25.785 in Notice 75-31 dealing with the design and location of seats, berths, safety belts, and harnesses, a proposed Airworthiness Directive (AD), Docket No. 14912, was issued on August 7, 1975 (40 FR 34139) proposing the removal of side-facing flight attendant seats and establishing criteria for the design, location, and removal of other flight attendant seats.

Both Notice 75-31 and the proposed AD contained similar proposals for flight attendant seats, and comments were received on both proposals. An AD was subsequently issued on February 23, 1976 (41 FR 8766) to require the removal of each side-facing flight attendant seat. The AD did not require corrective action on the other items contained in the proposed AD, since it was intended that the design or removal of other flight attendant seats would be considered in connection with final rulemaking action under Proposals 8-36 and 8-117 in Notice 75-31. Comments received on the proposed AD have been considered under related proposals in Notice 75-31. The energy absorbing rest requirement of proposed § 25.785(h)(2)(i) is intended to answer numerous comments received in the AD docket relating to allegedly hazardous characteristics of certain galley mounted flight attendant jumpseats now used in air carrier service. Since § 25.785(h)(2)(i) is specifically made applicable to air carrier operations in proposed § 121.311(f), present flight attendant jumpseats not designed to provide necessary arm, shoulder, head and spine support will be prohibited from use during air carrier operations upon the effective date of this amendment.

A commenter suggested that proposed § 25.785(g) only apply to required flight crew station seats and not to other flight deck seats such as rest seats or observer seats. The FAA does not agree. Nonrequired flight station personnel occupy seats that are very close to those of required personnel and, if these nonrequired flight station personnel are not properly restrained, their unrestrained movements during an emergency situation could interfere with operations by the flight crew. Therefore, the requirement of proposed § 25.785(g) is applicable to all seats on the flight deck.

Several commenters questioned whether the words "means to secure" in proposed §§ 25.785(g) and (h) were intended to require a specific device or whether an operational procedure could be used that would require that the seat belt and shoulder harness be secured when not in use. Another commenter questioned whether the fastening of the harness around the seat when not occupied would meet the intent of the rule. The intent of the proposal for §§ 25.785(g) and (h) is to provide a means or procedure for ensuring that the restraint system, when not in use, will not interfere with normal operation of the airplane or interfere with rapid egress of personnel in an emergency situation. The fastening of the restraint system around the seat would be acceptable if it meets this intent. The work "combined" which appears between the words "be" and "means" in the second sentence of proposed § 25.785(g) has been deleted as redundant. Several commenters questioned whether the term "when not in use" in proposed §§ 25.785(g) and (h) related to not in use on a particular flight or not in use due to the seat having been momentarily vacated. However, the wording makes clear that the rule would apply in both instances.

Numerous comments were received on proposed § 25.785(h) to require that flight attendant seats be located near approved floor level exits and be equipped with a combined seat belt and shoulder harness.

Several commenters suggested that applicability of the proposed paragraph be restricted to seats provided for those attendants required by the operating rules, since excess flight attendants usually occupy passenger seats and the redesign of passenger seats to accept approved shoulder harnesses would be prohibitive in cost. The FAA maintains that all flight attendants required by § 121.391 should have seats that meet the requirements of § 25.785(h). The phrase "required by § 121.391" has been deleted from § 121.311(f) and a new § 121.311(f)(3) has been added to clarify that the requirements of § 25.785(h) are not applicable to passenger seats occupied by flight attendants not required by § 121.391.

Two commenters suggested that shoulder harnesses not be required on rearward facing flight attendant seats, stating that a seat belt alone would offer secure and safe restraint. The FAA does not agree. Lateral restraint is required for rearward facing as well as for forward facing seats. A shoulder harness provides the degree of lateral restraint necessary to warrant its use at all flight attendant seats.

A commenter questioned whether mirrors could be used to meet the intent of the proposed § 25.785(h)(1), which would require that flight attendant seats be located to provide a view of the cabin area. The intent of the proposal is to require a direct view, and mirrors or other such devices are not considered acceptable because of their limitations. The proposed § 25.785(h)(1) is therefore revised to specify "direct view" and to make nonsubstantive editorial changes.

Two commenters stated that where galley doors are used as emergency exits, the placement of the attendant seats near the floor level exit, as required in proposed § 25.785(h), could preclude compliance with the requirement of proposed § 25.785(h)(1) that the flight attendants be provided a direct view of the cabin area. To cover this situation, a commenter suggested that the § 25.785(h)(1) requirement be conditioned to apply insofar as practicable and without compromising the proximity to required floor level exits. The FAA agrees that the requirement for location of the flight attendant seats near the floor level exits in this case is more important than the requirement that the flight attendant have a direct view of the cabin. Accordingly, the proposal is revised in the manner suggested.

Another commenter stated that access to the communication system when seated is not necessary for all flight attendants, and in particular those in excess of the number required by the operating rules. After further review, the FAA has concluded that the wording of proposed § 25.785(h)(1) referring to access to the communications system when seated may be ambiguous and cause misunderstandings when compared to the newly adopted provisions of §§ 25.1411(a)(2) and 121.319 of this Chapter (Amendment 7; 43 F.R. 50578). Newly adopted § 25.1411(a)(2) describes the requirements for the public address system microphone, whereas the § 121.319 requirement for a crewmember interphone system is also regarded as a communication system. However, there is no mention in Part 25 of the crewmember interphone described in § 121.319. To make the changes necessary to resolve this ambiguity would be beyond the scope of this proposal. Accordingly, the FAA has deleted the last portion of proposed § 25.785(h)(1) referring to access to the communications system when seated. The FAA will propose future rulemaking action to incorporate provisions in §§ 25.785(h)(2)(i) and (h)(2)(ii).

Four commenters objected to proposed §§ 25.785(h)(2)(i) and (h)(2)(ii) to require energy-absorbing rests on only rearward facing seats and suggested that forward facing seats also be required to have such rests. The FAA agrees, and the proposed § 25.785(h)(2) has been revised accordingly. A commenter suggested that the proposed § 25.785(h)(2) is redundant, since current § 25.785(c) already requires a seat with energy absorbing rests. The FAA does not agree. The § 25.785(c) requirement does not specify the energy absorbing rest that would be required by § 25.785(h)(2) for rearward and forward facing flight attendant seats.

Two commenters suggested deletion of the word "arms" if the intent is to require arm rests or side panels, for these would preclude the use of the fold-up seats needed to provide the necessary clearance and access to aisles and exits. The proposed rule is not intended to eliminate the use of fold-up seats. The intended arm support could be provided by a sufficiently large seat back, and this would not preclude the use of fold-up designs. Another commenter suggested that clarification of the work "energy absorbing rest" is necessary and suggested that the term "padding" was less confusing. The FAA believes that the term "energy absorbing rest" as currently employed in present § 25.785(c) is sufficiently clear and unambiguous. Moreover, introducing new terminology at this time would only lead to confusion.

Several comments were received on proposal § 25.785(h)(3), which would require that flight attendant seats be positioned to prevent interference with the use of passageways and exits. The commenters questioned whether the requirement would apply to unoccupied flight attendant seats. The FAA agrees that the proposed requirement should be clarified and it has been revised to indicate that the requirement applies to flight attendant seats when not in use. Revised § 25.785(h)(3) has been redesignated and adopted as § 25.785(h)(2)(ii).

A commenter suggested the addition of a new § 25.785(h)(4) to state requirements for the design and location of supplemental oxygen equipment for use by the flight attendants. Since standards for the location of such equipment are presently under consideration in the Operations Review, that suggestion will be treated as a part of the Operations Review rulemaking.

A commenter suggested deletion of the words "during any operation" from the proposed § 25.785(j), which would require that each seat be located to minimize the probability of its occupant suffering injury by being struck by dislodged items. The commenter stated that the phrase was meaningless, unnecessary, and would be a source of never-ending controversy as to its intent. The FAA agrees, and proposed § 25.785(j) has been revised accordingly.

Several commenters questioned whether the proposed § 25.785(j) was intended to pertain to all passenger and flight attendant seats or merely to flight attendant seats. A commenter suggested that injury from dislodged contents of galleys or storage compartments is common to all seats in the cabin and that the flight attendant seats should not be singled out for action. Consistent with the wording of the previously issued AD dealing with flight attendant seats, the intent of proposed § 25.785(j) in Notice 75-31 was directed to flight attendant seats. Although all occupants of an airplane should be protected from injury from dislodged items, the FAA does not agree that all occupants are vulnerable to flying debris by reason of seat location. The flight attendant seats, being adjacent to exits, are frequently in aisles, passageways, or near galleys, and are therefore more vulnerable to being struck by objects dislodged from closets, galleys, supply racks, or shelves. Service experience shows that flight attendants are struck more often than other cabin occupants and proposed § 25.785(j) is revised to clarify its applicabililty to flight attendant seats.

Another commenter suggested that a strict interpretation of proposed § 25.785(j) would result in an incompatibility with the requirements that cabin attendant seats be near or adjacent to approved floor level exits, especially when such exits are galley service doors. The commenter suggested inclusion of the phrase "insofar as is practicable and without compromising the proximity to approved floor level exits. . . ." The FAA does not agree. The requirement that flight attendant seats be located near approved floor level exits should not be compromised nor should locating such seats near galleys compromise the safety of the seated flight attendant. In this connection, proper galley design and seat location can greatly minimize the probability of the flight attendant being injured by dislodged items.

Finally, one commenter suggested a revision to § 25.785(j), by listing specific items to be considered in minimizing the likelihood of occupants being injured by dislodged items. The same commenter proposed that the description of likelihood of injury be changed from a "probability" to a "possibility". The FAA does not agree. Proposed § 25.785(j) would require that flight attendant seats be located to minimize the "probability" of occupant injury from dislodged items. Substantial design difficulties would be encountered in locating flight attendant seats to minimize harm from any possibility during flight operations. The commenter's proposal would create the unwarranted implication that seat locations be subject to statistical analysis. Nor is the necessary to enumerate all items capable of being dislodged, as the proposed wording would require that all items normally found in galleys, storage compartments, and serving carts must be considered. The same commenter's further suggestion for specifying means for securing all stowage compartments and related loose items is unnecessary since such structural considerations are adequately covered in the wording of § 25.785(j).

Disposition of Proposal 2-60 to amend § 25.785 (Notice 75-10) was deferred at the time of issuing the amendment published at 41 FR 55454 so that it could be considered in connection with Proposal 8-36. No unfavorable comments were received on Proposal 2-60. However, in view of the changes being made to § 25.785 under Proposal 8-36 of Notice 75-31, the changes proposed in 2-60 of Notice 75-10, with the exception of the word changes in paragraph (i) and the addition of a new paragraph (h), are unnecessary and are withdrawn. Proposed paragraph (h) concerning the forward observers' seat is adopted and redesignated as § 25.785(k).

Proposal 8-37. Two commenters objected to the wording "extremely improbable" in the proposed revision to § 25.787(b). One commenter stated that this wording implies a requirement for a reliability analysis, which the commenter indicated was unwarranted. The FAA concurs, and the requirement that an unwanted opening be extremely improbable is withdrawn.

Two commenters suggested that the intent of proposed § 25.787(b) is adequately covered in present § 25.789. However, the intent of the proposed section is to prevent inadvertent opening of the latched doors of stowage compartments by specifically requiring that service wear and deterioration be considered in the design. The § 25.787(b) requirement is therefore different than the § 25.789 requirement which is directed to retention of items of mass subjected to maximum load factors.

After consideration of the comments received and after further review, the FAA has determined that a clarification of the proposal is needed to indicate that the proposal applies only to stowage compartments in passenger and crew cabins. The proposal is revised accordingly.

Proposal 8-39. A commenter objected to the proposal for a new § 25.793 to require slip resistant properties on floor surfaces of all areas likely to become wet, stating that there appears to be no such hazard in general aviation airplanes. The FAA does not agree. Airplanes type certificated under Part 25 may be operated both as air carrier and general aviation type airplanes. Any transport category aircraft may be susceptible to this problem regardless of its type of operation.

A second commenter suggested that the wording of the proposal be revised to require consideration only of those areas "likely to become wet in service." The FAA agrees and the proposal is revised accordingly.

Several commenters questioned the term "slip resistant" as used in the proposal. A commenter stated that a definition of the term should be adopted. The FAA maintains that the term "slip resistant" is generally understood, and that no useful purpose would be served by providing a rigorous definition which might unduly restrict design choice.

Proposals 8-42, 2-18, 2-65, 2-114 and 2-160. Proposal 2-65 to revise § 25.853(c) is similar to Proposals 2-18, 2-114 and 2-160 to revise §§ 23.853(c), 27.853(c), and 29.853(c), respectively. Each of these proposals was set forth in Airworthiness Review Notice No. 2 (Notice 75-10) and their disposition was deferred for consideration with Proposal 8-42 (see Amendment No. 3 (41 FR 55454)). All comments on Proposals 2-18, 2-65, 2-114, and 2-160 are discussed herein.

Commenters pointed out that proposed § 25.853(c) contained "No Smoking" sign provisions which were already set forth in current § 25.791, and suggested that one or the other be revised to avoid confusion. The FAA agrees and § 25.853(c) has been revised to refer to § 25.791 for the requirements for signs that notify passengers when smoking is prohibited. Because of this revision to Proposal 8-42, § 25.853(c) is not identical to §§ 23.853(c), 27.853(c), and 29.853(c); however, substantively identical language exists in § 25.971, referenced in the revised § 25.853(c). If § 25.853(c) were to be identical to §§ 23.853(c), 27.853(c), and 29.853(c), corresponding changes to § 25.971 and § 121.317(a) would be necessary. Such changes would unnecessarily complicate this amendment and would provide no meaningful advantage.

A commenter objected to proposed § 27.853(c)(2) on the grounds that "No Smoking" signs are not justifiable for normal category rotorcraft, which are limited to 6,000 pounds gross weight. It was contended that the passenger capacity of such rotorcraft is relatively small and that even when the crew and passenger compartments are separated, a simple "No Smoking" placard, or oral instructions from the crew, or both, would accomplish the intent of the proposal. With regard to a "No Smoking" placard, the FAA agrees that such a placard would be sufficient if smoking is to be prohibited. However, the FAA believes that when the crew compartment is separated from the passenger compartment, oral communication from crew to passenger may not be possible.

A commenter suggested that the distinction between the term "when illuminated" in proposed § 27.853(c)(2)(i), and the term "when illuminated internally" in proposed § 27.853(c)(2)(ii), should be made more clear. The FAA's intent was to require the lights to be so constructed that the crew can turn them on and off, consistent with similar requirements in current §§ 25.791, 121.317 and 127.115. Accordingly, the term "when illuminated internally" is deleted from §§ 23.853(c)(2)(ii), 27.853(c)(2)(ii) and 29.853(c)(2)(ii).

Several commenters objected to the requirement in proposed § 25.853(d) (Proposal 8-42) that towel, paper, and waste receptacles be fireproof, contending that—(1) Experience and tests have demonstrated that proper design using fire resistant materials provides entirely adequate fire containment; (2) the other requirements in proposed § 25.853(d) ensure fire containment in fire resistant receptacles; and (3) use of fireproof rather than fire resistant materials would result in a considerable weight penalty, particularly on large airplanes. In light of these comments, and after further consideration, the FAA concludes that fire resistant materials would be adequate for these receptacles. Proposed § 25.853(d) is revised accordingly.

Two commenters pointed out that proposed § 25.853(d) could be construed as applying to towel and paper dispensing equipment. The FAA's intent was to cover only those receptacles that are used for the *disposal* of towels, paper, and waste since these are receptacles in which fires have occurred in service. To make this clear, § 25.853(d) is revised by inserting the word "disposal" before the work "receptacle."

A commenter objected to the term "extremely improbable" in proposed § 25.853(d) because it implies a type of reliability analysis which the commenter claimed would not be appropriate to the requirements specified. Another commenter objected to the same term on the ground that it would be impossible to demonstrate. The FAA agrees that "extremely improbable" is not appropriate and the second sentence of § 25.853(d) is revised to read ". . . under all probable conditions of wear, misalignment, and ventilation expected in service. . . ." The word "effects" is deleted as redundant.

One commenter stated that proposed § 25.853(d) would require that the receptacle have a lid and that this may not be practical when a chute leads from a spring-loaded door in the sink counter top into a container below. The FAA believes that a practical design complying with the proposal can be achieved by considering the combination of spring-loaded door, chute, and container as constituting the receptacle.

Two commenters objected to proposed § 25.853(e), stating that it was more restrictive than Airworthiness Directive (AD) 74-08-09, which deals with similar safety issues. In particular, the commenters stated that the AD allowed the use of— (1) "No Smoking" signs as an alternative to "No Smoking in Lavatory" signs; (2) signs "of sufficient size and contrast" as opposed to the proposed "red letters at least one inch high on a white background of at least two inches high"; (3) one ashtray to serve more than one lavatory door if the ashtray could be seen readily from the cabin side of each lavatory served. Concerning the first and third points, the FAA finds, after further consideration, that the less restrictive language in the AD would provide an adequate level of safety. Concerning the second point, the FAA believes it is necessary to require minimum standards for the size and contrast of the placards specified in proposed § 25.853(e). However, after further consideration, the FAA has concluded that these placards would be sufficiently conspicuous if the red letters and white background were one-half inch high and one inch high respectively Section 25.853(e) is revised accordingly.

A commenter suggested that proposed § 25.853(e) be revised to allow the use of symbols to indicate "No Smoking in Lavatory" instead of letters. The FAA maintains that for lavatory placards, letters rather than symbols must be used to minimize the probability that the placard message would not be understood by the lavatory occupant. In contrast to the situation in the general cabin area, there would not be a person nearby who could explain the symbol if its meaning were not grasped. However, symbols may be included on the placard with the letters to further describe the no smoking condition.

A commenter who supported proposed §§ 25.853(d) and (e) suggested that additional regulations should be developed to provide an active means of fire detection and extinguishing in compartments such as lavatories; however, the commenter did not make any specific recommendations.

Proposal 8-52. No unfavorable comments were received on the proposal to amend § 25.1413(c). Accordingly, the proposal is adopted without substantive change.

Proposal 8-116. Several commenters agreed in principle with the proposed § 91.200 to add a requirement that transport category aircraft be equipped with shoulder harnesses meeting the requirements of § 25.785 at each crewmember seat and flight attendant seat. Two of these commenters disagreed with the proposed one year compliance time, stating that two or three years was a more appropriate compliance time. The FAA finds that the one year proposed is a realistic time for accomplishing these tasks. However, the FAA recognizes that conditions beyond the control of an operator can occur to delay compliance with the rule. This could be the case even though a good faith effort was made by an operator to comply. Because of this, the proposal has been revised to provide, under appropriate circumstances, for a limited extension of the compliance date in accordance with a schedule acceptable to the FAA. Before granting any extension, the FAA will scrutinize each operator's request to determine if the operator made the showing required by § 91.200(b). In addition to demonstrating that circumstances beyond its control make timely compliance impossible, the operator must submit a schedule showing that compliance will be achieved at the earliest practicable date. Any extension granted will be based upon the FAA's judgment as to the earliest date on which compliance is possible.

A commenter stated that some airplanes do not have adequate structure available at some flight attendant and jump seat locations to install a supported shoulder harness, particularly at those seats which are side facing. However, side-facing seats are no longer an issue since Airworthiness Directive 76-05-02 (Docket No. 14912, Amendment No. 39-2534) requires the removal of side-facing flight attendant seats from all transport category airplanes.

A commenter suggested that the proposal be revised to require compliance only when flight attendants are being carried, rather than at all times a flight attendant seat is installed. The commenter pointed out that some airplanes operate under Part 91 when conducting ferry or training flights. The FAA does not agree, since Proposal 8-117 would require that shoulder harnesses be installed for operations conducted under Part 121 and they would therefore already be in the airplane for the operation described by the commenter.

Several commenters on Proposal 8-117 pointed out that certain existing shoulder harness installations at pilot-in-command, second-in-command, and flight engineer stations are designed to less than the present 9_g forward load factor requirement of § 25.785, and that to require a redesign to 9_g would be impractical and prohibitive in cost. Other commenters noted that many flight attendant seats already have FAA-approved shoulder harnesses but not all are "combinded safety belts and shoulder harness unit(s) with a single point release." The commenters stated that these installations have proved satisfactory in service and, since the operators voluntarily installed such FAA-approved shoulder harnesses, it would be unfair to now penalize them by requiring a retrofit restraint system with a single point release. The FAA finds that the comments submitted on Proposal 8-117 are equally appropriate for Proposal 8-116 and agrees with the commenters' recommendations. Proposed § 91.200 has been appropriately revised to allow the use of previously installed restraint systems at crewmember stations, provided the crewmember can perform assigned duties with the restraint system fastened, and it allows for existing restraint systems which were designed to the inertial load factors established under the certification basis of the airplane.

See proposals 8-117 and 8-36 for related discussions.

Proposal 8-117. As in Proposal 8-116, several commenters objected to the proposed changes to § 121.311 which would require shoulder harnesses at each flight deck station. Several commenters also pointed out that shoulder harness installations now exist on airplanes which are designed to less than the present 9_g requirements of § 25.785. Other commenters noted that many flight attendant seats already have FAA-approved shoulder harnesses but not all possess a single point release. For a discussion of all of these comments see Proposal 8-116. Qualifying statements have been added to the proposal to revise §§ 121.311(e) and (f). These changes are substantively identical to those added to § 91.200(a) and discussed in Proposal 8-116.

A commenter objected to the requirement in proposed § 121.311(f) that would require all flight attendant seats to meet the requirements of § 25.785 of this chapter. The commenter stated that some passenger seats are being used for required flight attendants due to their proximity to floor level exits. The FAA maintains that all flight attendants required by § 121.391 should have seats that meet the requirements of § 25.785. The phrase "required by § 121.391" has been deleted from § 121.311(f) and a new § 121.311(f)(3) has been added to clarify that the requirements of § 25.785(h) are not applicable to passenger seats occupied by flight attendants not required by § 121.391.

A commenter pointed out that there was no time period for effecting compliance and suggested at least two years be allowed for retrofit of these restraint systems. In order to provide some time for compliance, proposed § 121.311(f) is revised substantively identical to revised § 91.200(b) (see Proposal 8-116).

Several commenters pointed out that the compliance time proposed for §§ 121.311(e)(2), (f), (g), and (h) does not permit adequate time for design, fabrication, and retrofit. The FAA is satisfied that the time proposed is a realistic period for accomplishing these tasks. However, the FAA recognizes that conditions beyond the control of a certificate holder can occur to delay compliance with the rule. This could be the case even though a good faith effort was made by a certificate holder to comply. Because of this, proposed §§ 121.311(e)(2), (f) and (h) have been revised to provide, under appropriate circumstances, for a limited extension of the compliance date in accordance with a schedule acceptable to the FAA. Section 121.311(j) describes the prerequisites for any operator to obtain an extension of the compliance dates established by the amendment. To be eligible for an extension, each operator must demonstrate that it is unable to comply due to circumstances beyond its control. In addition, the operator must submit a schedule showing that compliance will be achieved at the earliest practicable date. Any extension granted under this provision will be based upon the FAA's judgment as to the earliest date on which compliance is possible.

A commenter pointed out that proposed § 121.311(h) requires that each occupant of a seat equipped with a shoulder harness have the restraint system secured about him/her during takeoff and landing but does not require the occupant to be able to perform assigned duties with the shoulder harness fastened. Since the obvious intent of proposed § 121.311(h) was to require that the occupant of the seat be able to perform assigned duties with the shoulder harness attached, proposed § 121.311(h) is revised accordingly.

No unfavorable comments were received on the proposal to amend § 121.311(i) and the proposal is adopted without substantive change.

Proposal 8-118. The FAA withdrew the proposed new § 121.312(b) in a Notice published in the Federal Register on August 24, 1978 (43 FR 37703).

A commenter pointed out that airplanes in service have already been required to comply with the essential substance of proposed new § 121.312(c) by means of Airworthiness Directive 74-08-09, which applies to all transport category airplanes, and recommended that this proposal be deleted. The FAA agrees. Airworthiness Directive 74-08-09 applies to airplanes operated under Parts 91, 121, and 135 of the Federal Aviation Regulations, and the proposed new § 121.312(c) is redundant with respect to airplanes operated under Part 121. The proposed new § 121.312(c) is therefore withdrawn.

Proposal 8-119. No unfavorable comments were received on the proposal to delete § 121.321. Accordingly, the proposal is adopted without substantive change. For related discussion see Proposal 8-117.

ADOPTION OF THE AMENDMENT

Accordingly, Parts 23, 25, 27, 29, 91, and 121 of the Federal Aviation Regulations are amended effective March 6, 1980.

(Sections 313(a), 601, 603, and 604 of the Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421, 1423, and 1424); and Section 6(c) of the Department of Transportation Act (49 U.S.C. 1655(c)).)

NOTE: The FAA has determined that this document involves a proposed regulation which is non-significant under Executive Order 12044 as implemented by DOT Regulatory Policies and Procedures (44 FR 11034; February 26, 1979). A copy of the regulatory evaluation prepared for the regulations is contained in the regulatory docket. A copy of it may be obtained by contacting the person identified above under the caption "FOR FURTHER INFORMATION CONTACT . . ."

Amendment 27-18

Airworthiness Review Program—Amendment No. 8A: Aircraft, Engine, and Propeller Airworthiness, and Procedural Amendments

Adopted: August 27, 1980 **Effective: October 14, 1980**

(Published in 45 FR 60154, September 11, 1980)

SUMMARY: These amendments to the Federal Aviation Regulations update and improve the airworthiness standards applicable to the type certification of aircraft, engines, propellers, related operating rules, and procedural requirements. These amendments are part of the Airworthiness Review Program.

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SUPPLEMENTARY INFORMATION:

These amendments are the ninth and last in a series of amendments issued as part of the Airworthiness Review Program. The following amendments have previously been issued as part of this program:

	Title and FEDERAL REGISTER (FR) Citation
Amendment No. 1:	Form Number and Clarifying Revisions (40 FR 2576; Jan. 14, 1975)
Amendment No. 2:	Rotorcraft Anticollision Light Standards (41 FR 5290; Feb. 5, 1976)
Amendment No. 3:	Miscellaneous Amendments (41 FR 55454; Dec. 20, 1976)
Amendment No. 4:	Powerplant Amendments (42 FR 15034; March 17, 1977)
Amendment No. 5:	Equipment and Systems Amendments (42 FR 36960; July 18, 1977)
Amendment No. 6:	Flight Amendments (43 FR 2302; Jan. 16, 1978)
Amendment No. 7:	Airframe Amendments (43 FR 50578; Oct. 30, 1978)
Amendment No. 8:	Cabin Safety and Flight Attendant Amendments (45 FR 7750; Feb. 4, 1980)

These amendments are for the most part based on Notice 75-31 which was published in the FEDERAL REGISTER on July 11, 1975 (40 FR 29410), as well as a number of proposals contained in the following notices of proposed rule making: Notice 75-10 (40 FR 10802; March 7, 1975); Notice 75-19 (40 FR 21866; May 19, 1975); and Notice 75-26 (40 FR 24802; June 10, 1975). Amendments based on the latter three notices have already been issued as a part of the Airworthiness Review Program, specifically those titled Miscellaneous Amendments, Powerplant Amendments, and Airframe Amendments, respectively. Final action on certain of the proposals was deferred, however, at the time the amendments were issued as further consideration and review of these proposals was considered necessary. In other cases, final action was deferred so that they could be considered together with related proposals contained in other notices.

Certain proposals identified as Group 2 in Appendix I to Notice 75-31 were deferred to be dealt with in a later notice as a part of the Airworthiness Review Program. These proposals all addressed the concept of periodically updating the certification basis of airplane models in long-term production. Such recertification every five or ten years would be intended to ensure that the level of safety of all airplanes in service keep pace with the current level of safety expectations. The FAA has now determined that these proposals more appropriately should be examined as a separate issue in a future regulatory action. Accordingly, the proposals identified as Group 2 in Appendix 1 to Notice 75-31 are being dropped from the Airworthiness Review Program.

Proposals relating to cabin safety and flight attendants, which are identified in this amendment, were extracted from Notice 75-31 (40 FR 29410; July 11, 1975) and handled on an expedited basis. Those rules were published in the Cabin Safety and Flight Attendant Amendments (45 FR 7750; February 4, 1980).

Interested persons have been given an opportunity to participate in the making of these amendments and due consideration has been given to all matters presented. The proposals and comments are discussed below. Substantive changes and changes of an editorial and clarifying nature have been made to the proposed rules based upon relevant comments received and further review within the FAA. Except for minor editorial and clarifying changes and the substantive changes discussed below, these amendments and the reasons for them are the same as those contained in Notices 75-10, 75-19, 75-26, and 75-31.

DISCUSSION OF COMMENTS

The following discussions are keyed to the like-numbered proposals contained in Notices 75-10, 75-19, 75-26, and 75-31, and are presented in the same order as the corresponding amendments found in the rules portion of this document.

Proposal 8-1. The proposal to amend § 1.1 in order to transfer the definitions for rated power and thrust to a new § 33.6 is withdrawn. It is considered that such a change may introduce confusion in the administration of aircraft certification rules. See also Proposal 8-94.

Proposal 8-2. Several commenters object to proposed § 21.16(a) which would delete reference to a "novel and unusual design feature" as a necessary condition for the Administrator to issue special conditions. Special conditions become a part of the designated applicable regulations for type certification of a particular product (aircraft, aircraft engine, or propeller).

One commenter indicates that the proposed revision is unjustified and would lead to indiscriminate rule making, and that instead of simplifying the administration of the requirements it would introduce complexity. Another commenter claims that adoption of proposed § 21.16(a) would introduce uncertainty into design requirements.

One commenter suggests that in lieu of revising § 21.16, the FAA should perform a study of § 21.21(b) (2). (Section 21.21(b) (2) provides for denial of a type certificate if an unsafe feature or characteristic exists in the design under consideration. Before adoption of § 21.16, FAA used § 21.21(b) (2) to issue special conditions in letter form.) This commenter suggests that if § 21.21(b) (2) were to continue to be used to issue special conditions to cover an unsafe design feature or characteristic that is not "novel or unusual," it must be equally applicable to a condition that exists on more than one (earlier certificated) product, further stating that the other product or products must then have been type certificated using existing rules which did not adequately cover the unsafe design feature or characteristic. On this premise, the same commenter asks several relevant questions. When § 21.21(b) (2) is applied, does the FAA make it retroactive to the other involved models? Are Airworthiness Directives (Part 39) issued? Why wasn't a special condition issued against the first applicant when the condition was, in fact, novel or unusual? Why was this not followed by a notice of proposed rule making for future application?

These comments and questions caused the FAA to completely reevaluate its practices in designating the applicable regulations for type certification under § 21.17(a), commonly referred to as defining a "type certification basis."

After further consideration of the comments received as well as FAA practice in designating the applicable regulations, and the objectives of proposed § 21.16, the FAA agrees that this proposal should be withdrawn because of the potential for possible abuse of general rulemaking procedures, of the requirements of the Administrative Procedure Act, and the intent of Executive Order 12044. As explained below, the objectives of proposed § 21.16 will be satisfied by the application of a new FAA policy affecting the designation of applicable regulations for the type certification of new aircraft, aircraft engines, and propeller designs. These future practices are consistent with the FAA General Rule-Making Procedures of Part 11, the Administrative Procedure Act, and Executive Order 12044.

Section 21.16 is one paragraph of a number of paragraphs used to define the type certification basis of a new product. Companion paragraphs of importance to this discussion include §§ 21.17 and 21.21. Section 21.17(a) provides that the applicable airworthiness standards are (1) those requirements of this subchapter that are effective on the date of application for a type certificate, unless otherwise specified by the Administrator or unless compliance with later effective amendments is elected by the applicant or required by special retroactive regulations (e.g., § 25.2), and (2) any special conditions prescribed by the Administrator in accordance with § 21.16. Section 21.16 provides for the issuance of special conditions when the Administrator finds that the existing airworthiness standards do not contain adequate or appropriate safety standards *because of novel or unusual design features* of the product to be type certificated. Section 21.21(b) (1) permits noncompliance with specific provisions of the airworthiness standards when there are compensating factors that provide an equivalent level of safety. Such determinations are commonly referred to as "equivalent safety findings." Section 21.21(b) (2) provides for the denial of a type certificate, notwithstanding a showing of compliance with the applicable airworthiness standards designated in accordance with § 21.17, if the Administrator finds an unsafe feature or characteristic of the product for the category in which certification is requested.

Sections 21.16, 21.17, and 21.21, taken together with FAA policy in designating the applicable regulations must recognize and balance four important considerations: (1) the FAA has an obligation under Section 601 of the Federal Aviation Act of 1958 to keep the airworthiness standards of this subchapter (i.e., FARs 23, 25, 27, 29, 31, 33, and 35) as current as practicable; (2) the type certificate applicant has a right and a need to know, in very specific terms, what the applicable airworthiness standards will be in order to finalize the detail design of its product and to enable the applicant to make reasonable performance guarantees to its potential customers; (3) in the interests of safety, rapid technological advances presently being made by the civil aircraft industry require that the FAA be able to issue special conditions to address truly novel or unusual design features that it has, as yet, not had an adequate opportunity to envisage in the airworthiness standards through the general rulemaking process; and (4) because the airworthiness standards of this subchapter are intentionally objective in nature to allow flexibility in design, the FAA must retain the prerogatives both to make equivalent safety findings and to deny a type certificate whenever an unsafe design feature or characteristic is found during the type certification process.

The phrase "novel or unusual" as used in § 21.16 is a very relative term. As used hereafter in applying § 21.16 to justify the issuance of special conditions, "novel or unusual" will be taken with respect to the state of technology envisaged by the applicable airworthiness standards of this subchapter. It must be recognized that in some areas which will vary from time to time the state of the regulations may somewhat lag the state of the art in new design because of the rapidity in which the state of the art is advancing in civil aeronautical design and because of the time required to develop the experience base needed by the FAA to proceed with general rule making. Applicants for type certification of a new design have the opportunity to mitigate the impact of not knowing the precise airworthiness standards to be applied for "novel or unusual design features" by consulting with the FAA early in their certification planning when such features are suspected or known by the applicant to exist. It should also be recognized that, because of the intentional objective nature of the airworthiness standards of this subchapter, many new design features which might be thought of as "novel or unusual design features" may already be adequately covered by existing regulations, thus obviating the need to issue special conditions.

Henceforth, the special condition will not be issued for general upgrading of the applicable airworthiness standards when novel or unusual design features are not involved. Whenever the FAA determines that an upgrading of the airworthiness standards of this subchapter is warranted, the upgrading will be promulgated as an amendment to this subchapter consistent with the general rulemaking procedures of FAR Part 11, the Administrative Procedure Act, and Executive Order 12044. Should the FAA conclude that there is a compelling safety need to apply a proposed amendment retroactively to designs already type certificated or to designs for which a type certificate application is in progress, the retroactive aspects of the proposed amendment, if supportable by a regulatory analysis completed in accordance with Executive Order 12044, will be announced in the notice or proposed rule making for that amendment. Public comments on the proposed retroactive aspects will be considered in determining the applicability of the adopted rule.

A number of products for which special conditions have not as yet been issued are undergoing type certification at the time of this amendment. Should the FAA conclude that recent or future amendments to this subchapter should be applied to these products that would not otherwise be applicable under § 21.17(a) (1) then an amendment to require retroactive application will be proposed and acted upon through the general rulemaking process explained above, in lieu of issuing special conditions under § 21.16.

Also, the provisions of § 21.21(b) (2) will no longer be used to justify the issuance of special conditions. However, just as an Airworthiness Directive may be issued under Part 39 to require the correction of an unsafe condition that is likely to exist or develop in a product of the same type design, notwithstanding a showing of compliance with the applicable airworthiness standards, § 21.21(b) (2) may continue to be used to deny issuance of a type certificate if a similar unsafe feature or characteristic is found during the type certification process, notwithstanding a showing of compliance with requirements designated by § 21.17. The unsafe features and characteristics envisaged by § 21.21(b) (2) are those related to specific design configuration or product characteristics of a particular design, that one would not normally expect the applicable airworthiness standards to specifically preclude because of their intentionally objective nature.

It is the practice of the FAA to develop and publish a Type Certificate Data Sheet as an integral part of each type certificate. The type certification basis is recorded on the Type Certificate Data Sheet for public information. In the future the type certification basis statement will identify not only the applicable regulation, including special conditions, but also will identify all exemptions issued pursuant to Part 11, together with "equivalent safety findings" made in accordance with § 21.21(b) (1).

For the above reasons, Proposal 8-2 is withdrawn.

In considering its disposition of the proposal to amend § 21.16(a), the FAA realizes that a "novel or unusual design feature" today may become a common design feature of the future. The issuance of a like special condition for several product designs will most likely compel general rule making on that subject and the history of that special condition could have a very strong influence on thinking when general rule making is initiated. Also, although special conditions are regulations of particular product applicability, they are issued only in the interest of public safety. For these reasons, Part 11, and § 21.16 of Part 21 are amended to require special conditions to be issued in accordance with the existing general rule-making procedures. As is now the case, a docket will continue to be maintained for each set of special conditions, and all material in the docket will continue to be available for public review.

Proposal 8-3. This proposal is one of a group of proposals dealing with the establishment of Instructions for Continued Airworthiness and the responsibilities of maintenance personnel and aircraft operators with respect to those instructions. The group is made up of the following proposals: 8-3, 8-5, 8-21, 8-25, 8-58, 8-62, 8-64, 8-67, 8-77, 8-80, 8-89, 8-91, 8-92, 8-93, 8-97, 8-98, 8-99, 8-104, 8-106, 8-107, 8-110, and 8-111.

A commenter representing a number of scheduled air carriers objects to the requirement in § 21.31(c) that the type design include the Airworthiness Limitations section of the Instructions for Continued Airworthiness because of the information to be included in that section. Although this commenter does not object to including mandatory replacement times for life-limited parts in the Airworthiness Limitations section, the commenter strongly objects to including inspection intervals and related procedures. Under proposed §§ 43.16 and 91.163(c), the commenter points out, air carriers would be required to comply with these maintenance-related airworthiness limitations. The FAA does not agree that inspection intervals and related procedures can be omitted from the Airworthiness Limitations section of the Instructions for Continued Airworthiness. For example, the proposed Airworthiness Limitations section on a transport category airplane must contain mandatory inspection intervals and related procedures because the damage-tolerance concept described in § 25.571 is predicated upon the use of such inspections to detect initial cracks in principal structural elements before crack growth under repeated loads could progress to a degree which would cause catastrophic failure of the airplane. However, the FAA does agree that §§ 43.16 and 91.163(c) should permit modification of these intervals and procedures by other FAA approved methods. Accordingly, inspection programs approved under §§ 121.25(b), 121.45, 121.367, 123.21(b), 127.13(b), 127.133, 135.5, 135.17, 135.419, 135.421, and 135.425, as defined by approved operations specifications, or an inspection program approved under § 91.217(e) constitute acceptable alternatives. The appendices to Parts 23, 25, 29, 31, 33, and 35 as adopted in this amendment require the applicant to specify (in the Airworthiness Limitations section) mandatory replacement times, inspection intervals, and related procedures. Sections 43.16 and 91.163(c) have been revised to show that only the inspection times and procedures may be adjusted under approved alternative programs.

A commenter objects to § 21.31(c), which in general is applicable to manufacturers, since continued airworthiness, which is covered in the paragraph, is the responsibility of the operator. Because this comment pertains more directly to § 21.50, it is dealt with in conjunction with Proposal 8-5.

In addition to comments relating to the Instructions for Continued Airworthiness, a commenter objects to § 21.31(a) because the proposal to include a list of drawings and specifications in the type design was not mentioned at the Airworthiness Review Conference. In fact, this proposal did appear as an FAA comment on Proposal No. 565 in the Committee I Workbook (titled "Procedures and Special Subjects") made available to all participants at the conference, and may be found in the docket.

Several commenters object to § 21.31(d) because including analyses in the type design—(1) would be redundant, since it is already required as part of the substantiating data; (2) is unnecessary, since the drawings and specifications required under current § 21.31(a) provide the general information needed by the FAA; and (3) introduces the possibility that the FAA would require the manufacturer to provide any and all data used to prepare the drawings and specifications, thereby delaying type certification. The FAA agrees that proposed § 21.31(d) would serve no useful purpose and it is withdrawn.

Proposal 8-4. A commenter objects that § 21.35(b) (2) eliminates flight testing for reliability, contending that analysis and ground test are not dependable as a basis for certification. In the light of this comment, and after further consideration and experience, the FAA has determined that flight testing for reliability does provide safety information not necessarily obtainable from analysis and ground test. Accordingly, the proposal to delete the reference to reliability in § 21.35(b) (2) is withdrawn.

No adverse comment was received on the proposal to replace the word "airplanes" in § 21.35(b) (2) with the word "aircraft" and this amendment to § 21.35(b) (2) is adopted without change.

Proposal 8-5. A commenter objects to the continued airworthiness provisions of § 21.50(b) (and also proposed § 21.31(c)) contending that—(1) continued airworthiness is the responsibility of the operator/owner; (2) current regulations in Parts 23 and 25 already require manufacturers to make available recommended maintenance procedures for the product at the time of its delivery; (3) current operating rules require the operator/owner to establish and comply with a maintenance program; and (4) with respect to transport airplanes, the present FAA Maintenance Review Board (MRB) system is an entirely satisfactory way of establishing the means for maintaining airworthiness. Current FAA practice allows operators of new transport category airplanes to utilize FAA MRB recommendations (reference FAA Advisory Circular No. AC 121-22) for starting their maintenance programs, and then vary them with FAA approval as experience and operating conditions dictate. The commenter points out that, contrary to that practice, the amendment will require the manufacturer to obtain FAA approval of its recommended maintenance procedures before the airplane is type certificated, and to obtain FAA approval of revisions to those procedures (necessitated by any improvement change in the airplane) before approval of the change itself. This, the commenter states, will impose a severe and unnecessary hardship on the manufacturer.

On the first and second points, although the operator/owner does have responsibility for continued airworthiness, the FAA has found that the recommended maintenance procedures made available under current regulations are frequently inadequate in scope and content, and often do not provide a sound basis for the operator/owner to maintain the airworthiness of the aircraft. The FAA has concluded that the lack of such recommended maintenance procedures can best be remedied by requiring that they be made available to owners and operators by the type certificate or supplemental type certificate holder. On the third point, while it is true that not all operators/owners are required to establish and comply with a continuous airworthiness program, those that voluntarily wish to set up such a program are often handicapped by the lack of comprehensive instructions, which would be remedied by § 21.50(b). On the other hand, those required to establish a program will benefit from the more detailed and comprehensive instructions made available to them under § 21.50(b). On the fourth point, which is directed toward aircraft that will be maintained in accordance with an FAA approved operations specification and maintenance program under Parts 121, 123, 127, 135, or an approved inspection program under § 91.217(e), the FAA recognizes that these procedures for maintaining airworthiness of the products have functioned satisfactorily. In this regard, the FAA expects that operating segments of the air transportation industry would continue to work with type certification applicants in defining adequate maintenance instructions prior to type certification. The FAA MRB document, which is a product of contributions made by both the operators and manufacturer, could be picked up by the type design holder and included as a part of the required Instructions for Continued Airworthiness, thus continuing the usefulness of the existing MRB practices for the original entry into service of new product designs. Likewise, the additional maintenance instructions that would be required and which are not typical to MRB documents, but are presently required in air carrier operators' FAA approved maintenance programs, could also be picked up by the type design holder. Therefore, the screening process that would be utilized by the FAA in reviewing such maintenance documents would not unnecessarily delay type certification or approval of design changes after certification. See also the discussion under Proposal 8-3.

A commenter questions the need for the provision in § 21.50(b) requiring that the Airworthiness Limitations section of the Instructions for Continued Airworthiness be furnished with each aircraft, engine, or propeller. The FAA agrees that this provision is unnecessary, as the type certificate holder must make the manual available, and the operator/owner must comply. To require a manual to be furnished with each equipment would be redundant, and in some instances, would be unnecessary. Accordingly, the requirement that the Airworthiness Limitations section be furnished with each airplane or product is revised to require that the section be furnished to each owner of the type.

A commenter objects to § 21.50(b) insofar as it applies to rotorcraft type certificated under Parts 27 and 29, contending that the manufacturer is already required under those parts to furnish a maintenance manual, which has allegedly been proven adequate. The FAA does not agree. The proposed Instructions for Continued Airworthiness, which are broader in scope and more detailed than the maintenance manual currently required under Parts 27 and 29, would provide the operator/owner with the minimum amount of information needed to maintain the airworthiness of increasingly complex rotorcraft currently being designed.

A commenter suggests that § 21.50(b) be revised to make it clear that an aircraft manufacturer need not supply Instructions for Continued Airworthiness pertaining to engines and propellers until the complete aircraft is delivered to the first retail purchaser. The continued airworthiness instructions for propellers and engines should be provided to the aircraft manufacturer to facilitate transmittal to purchasers of the aircraft.

A commenter notes that § 21.50(b) would require an aircraft manufacturer to make the Instructions for Continued Airworthiness available to the owner upon delivery of the aircraft and to any other person required to comply with any of the terms of those instructions *upon request.* Since such a request could be made before the first aircraft delivery, it could impose an unnecessary burden on the aircraft manufacturer. The commenter suggests that § 21.50(b) be revised so that such a request need not be filled until after delivery of an aircraft to the first owner. The FAA agrees that an early request for the Instructions for Continued Airworthiness could impose an unnecessary burden on the manufacturer. Additionally, the FAA notes that airplanes can be delivered to an operator, prior to full type certification, with a provisional airworthiness certificate to allow activities such as crew training, and therefore prior to the approval of the Airworthiness Limitations section. Accordingly, the phrase "upon request" has been deleted from § 21.50(b) and the language has been revised to require that at least one set of the complete Instructions for Continued Airworthiness be furnished upon delivery to the customer, or subsequent to issuance of the first standard certificate of airworthiness, whichever occurs later.

Proposal 8-6. Commenters object to the proposal to make § 21.97(b) applicable to all products rather than to engines only because—(1) the volume of paperwork would increase out of proportion to any benefits that might be gained; (2) the applications for supplemental type certificates would be significantly more complex, since there are frequently many configuration variations within an aircraft model and a fleet operator would have to list all of the configurations or make separate application for each; and (3) the term "specific configuration" must be defined if the proposal is to be properly administered. In light of these comments and after further consideration, the FAA concludes that this proposal requires additional study and it is withdrawn.

Proposal 8-7. No unfavorable comment was received on the proposal to amend § 21.123 to require a manufacturer to submit a manual describing its production inspection system and means for controlling materials and parts. Accordingly, the proposal is adopted without substantive change.

Proposal 8-8. A commenter objects to § 21.143(a) (2) contending that substitution of the word "supplier" for "subsidiary" introduces a major change to the requirements, involving increased paperwork and costs. The FAA does not agree. The FAA has consistently administered § 21.143(a) (2) as applying to *all* raw materials, purchased items, parts, and assemblies supplied to the prime manufacturer. The change does not involve increased paperwork or costs because it is a semantic change which clarifies the definition of persons or entities subject to the quality control data requirements of § 21.143, without expanding any of those requirements. The use of the term "subsidiary" is unclear because it implies that there must be a corporate connection between the prime manufacturer and his supplier. Accordingly, the language has been revised to reflect the FAA's intent that the quality control data requirements of § 21.143(a) (2) apply to all "suppliers" of each prime manufacturer. For similar reasons and for internal consistency, § 21.143(b) is revised to replace the term "subsidiary manufacturers" with the term "suppliers".

Proposal 8-9. No unfavorable comment was received on the proposal to amend § 21.182 to ensure that the proposed new § 45.11(c) is cross referenced. Accordingly, the proposal is adopted without substantive change.

Proposal 8-10. A commenter raises the question whether a special flight permit issued under § 21.197(a) (3) would serve as a certificate of airworthiness for international flights. The FAA notes that international flights cannot be conducted under special flight permits issued under § 21.197 unless specifically authorized by the foreign authorities concerned.

Another commenter objects to § 21.197(a) (3) (ii) because as worded, the individual aircraft would have to be flown for at least 50 hours, thereby defeating the purpose of the original proposal (as submitted for the Airworthiness Review) which aimed at eliminating unnecessary delays in obtaining FAA approval of customer demonstration flights. The commenter suggests that this provision be changed to stipulate that the aircraft type must have been flown for at least 50 hours. The FAA agrees that since the proposal concerns aircraft manufactured under a production certificate, and since the aircraft type could have been flown for at least 50 hours during the type certification program, the 50 hours of flight provision is not necessary. However, the FAA does not agree with the commenter's suggested revision. It is necessary to require that production flight tests for the individual aircraft involved be satisfactorily completed before that aircraft is flown on customer demonstration flights. Accordingly, § 21.197(a) (5) is added to prescribe this condition in place of the 50 hours of flight provision.

The same commenter also suggests that § 21.197(a) (3) (ii) should be made applicable to aircraft produced under a type certificate only, since such aircraft received close production surveillance by the FAA. The FAA agrees that a production certificate should not be the limiting factor in obtaining FAA approval of customer demonstration flights. If the aircraft has been demonstrated to otherwise meet all the safety requirements for a standard airworthiness certificate, then customer demonstration flights could be permitted. This proposal is adopted by the addition of § 21.197(a) (5).

In addition, the commenter suggests that proposed § 21.197(a) (3) (ii) be amended with a reference to the maintenance and inspection programs called for under § 21.195 for Experimental and Subpart C Provisional Type Certificates. Such procedures would unnecessarily complicate the issuance of permits for customer demonstration flights and would in effect nullify the original proposal. The portion of the proposal calling for maintenance and inspection programs in these instances is therefore withdrawn.

Proposal 8-11. No unfavorable comments were received on the proposal to amend § 23.253(b) (3) to ensure that high speed buffeting does not become severe enough to prevent the pilot from reading the instruments or controlling the airplane. Accordingly, the proposal is adopted without substantive change. Also see Proposal 8-28.

Proposal 8-12. No unfavorable comments were received on the proposal to amend § 23.361 to redefine the limit engine torque load conditions to be considered for turbine engine installations and to make other clarifying changes. Accordingly, the proposal is adopted without substantive change.

Proposal 8-13. The FAA does not agree with a commenter who suggests that the lead-in of § 23.371 be revised to make the gyroscopic load requirements applicable to piston as well as turbine engines. The FAA has no information to indicate a need for coverage of piston engines in this regulation, nor was any submitted by the commenter.

Another commenter concurs with § 23.371, assuming that a rational analysis of loads under § 23.371(a) is an alternate to the loads specified in § 23.371(b). This assumption is correct. No change to § 23.371 was proposed in this regard. Section 23.371 is adopted without substantive change.

Proposal 8-14. A commenter suggests that the word "operated" in § 23.729(c) be replaced by the word "lowered". The commenter states that the intent of the rule is to ensure that the gear can be lowered in an emergency. The FAA concurs, but the word "extended" is used to preserve the internal consistency of the section. Section 23.729(c) is revised accordingly.

This commenter also questions whether § 23.729(e) would require an "up lock". The commenter is evidently referring to a "lock" in the sense of a positive means other than hydraulic pressure, as required to keep the gear extended by § 23.729(b). Section 23.729(e) contains no such requirement.

Another commenter suggests that the second sentence of § 23.729(e) be revised to add the words "and secured" after the words "fully extended" and "fully retracted" in order to clarify what functions the lights would indicate to the pilot. The first sentence of the paragraph clearly states that the indicators should inform the pilot that the gear is secured in the extended or retracted position.

A commenter states that the proposal is redundant since the requirement is already in effect. The FAA does not agree. This is one of several new provisions being incorporated into the current regulations to assure the reliability of small land-plane landing gear systems.

After further review, the FAA has determined that the words "and warning device" should be removed from the heading of § 23.729(e) to preclude confusion between the requirements of this paragraph and those of § 23.729(f). Section 23.729 is adopted with editorial changes and the revisions discussed.

Proposal 8-15. A commenter objects to § 23.903(f) on the grounds that it imposes new and unjustified criteria for restart capability of reciprocating engine powered airplanes. The FAA believes the requirement to be fully justified. Accidents have occurred with multiengine reciprocating powered, as well as turbine powered airplanes because pilots have not been adequately apprised of the engine restart envelope for their airplane. Therefore, the requirement must apply to both types of engine installations.

This commenter further states that § 23.903(g) is acceptable provided that the "restart requirement is understood to be within the restart envelope for the aircraft (if one is approved for the aircraft)." Present § 23.903(e) (3), as applicable to turbine engine powered small airplanes, states that it must be possible to restart an engine in flight, and § 23.903(f) requires that an approved restart envelope be established. Therefore, development of a restart envelope would be required for the approval of each turbine engine powered small airplane. As adopted, § 23.903(g) requires that, following in-flight shutdown of all engines, electrical power for ignition exists throughout the approved restart envelope.

Another commenter states that it seems inconsistent to require that electrical power be provided for ignition but not for rotational capability sufficient for an engine start. The FAA does not agree. As adopted, the rule provides for those circumstances where engine windmilling speed is sufficient for restarting but insufficient to provide electrical power for ignition.

The proposal is adopted without substantive change. However, § 23.903(f) is revised to make it clear that the specified in-flight engine restart capability is required throughout the required altitude and airspeed envelope.

Proposal 8-16. No unfavorable comment was received on adding a new § 23.905(d) referencing propeller blade pitch control system durability requirements. Accordingly, § 23.905(d) is adopted without substantive change. For discussion of a related proposal to add a new § 35.42, see the discussion under Proposal 8-103.

Proposal 8-17. A commenter suggests that since the requirement for fuel tanks to retain fuel during a landing with landing gear retracted or collapsed may be subject to individual interpretation, advisory material on compliance methods should be reviewed with industry prior to implementation of the rule. The FAA does not agree. The revision merely clarifies an existing requirement. Section 23.967 is adopted without substantive change.

Proposal 8-18. A commenter recommends that the proposal to add a new § 23.991(d) which requires that operation of any fuel pump does not adversely affect continuous engine operation, be withdrawn or its adoption delayed while the compatibility of engine and airplane fuel systems is studied. The compatibility between these systems must be established in the design process, and the relevant design considerations are well known. Delaying the requirement in favor of additional study is not warranted.

Another commenter contends that the requirement is beyond the needs of safety. The FAA agrees that the proposed requirement is too restrictive and § 23.991(d) is revised to provide that the operation of any fuel pump may not affect engine operation so as to create a hazard.

Two commenters disagree with adding a new § 23.991(d), contending that it eliminates present fuel system designs. The FAA has no information to suggest that compliance with the revised section, as discussed above, would be impossible using present fuel system designs, nor was any presented by the commenter.

The proposal is adopted with the revision discussed above.

Proposal 8-19. No unfavorable comments were received on the proposal to amend § 23.1305(n) to permit movement of the propeller blade up to 8° below the flight low pitch position before an indication of the movement is required for the flight crew. Accordingly, the proposal is adopted without substantive change.

Proposal 8-20. For comments related to withdrawal of the proposal to revise § 23.1521(a), see Proposal 8-94.

Proposal 8-21. Since the proposal for § 23.1529 is substantively identical to those for §§ 25.1529 (Proposal 8-58), 27.1529 (Proposal 8-64), and 29.1529 (Proposal 8-77), all comments on these proposals are considered here.

A commenter notes that although the explanation for § 23.1529 makes it clear that the Instructions for Continued Airworthiness need not be finalized until delivery of the first airplane, the proposal itself seems to require that they be finalized before type certification. The commenter suggests that this point be clarified. The FAA agrees, and §§ 23.1529, 25.1529, 27.1529, 29.1529, 31.82, 33.4, and 35.4, are revised accordingly.

In response to a commenter representing a group of scheduled air carriers, the FAA notes that, except for the Airworthiness Limitations section, there is no requirement that any operator/owner use the Instructions for Continued Airworthiness referred to in §§ 23.1529, 25.1529, 27.1529 and 29.1529. Moreover, the new §§ 43.13(a), 43.16, and 91.163(c) allow the use of other methods. In particular, the use of maintenance manuals and continuous airworthiness maintenance programs developed under current Parts 121, 123, 127, and 135, or an inspection program approved under current § 91.217(e), would be acceptable alternatives to the Airworthiness Limitations section. This commenter suggests that language be added to § 25.1529 to make it clear that alternatives to the Instructions for Continued Airworthiness (except the Airworthiness Limitations section) may be used. This suggestion was not adopted because §§ 43.16 and 91.163(c) make this provision sufficiently clear.

Proposal 8-22, 8-23, and 8-24. Final action on Proposals 8-22, 8-23, and 8-24 was taken in Airworthiness Review Program, Amendment No. 7: Airframe Amendments (43 FR 50578; Oct. 30, 1978).

Proposal 8-25. The proposals to add an appendix to Parts 23, 25, 27, and 29 (Proposals 8-62, 8-67, and 8-80) setting forth Instructions for Continued Airworthiness are substantively identical and are discussed below. Unless otherwise stated, the discussion refers to the designated sections in each of the appendices mentioned above.

§ *XX.1(a).* A commenter objects to the concept of specifying requirements (as opposed to providing guidance) for the preparation of Instructions for Continued Airworthiness, contending that such requirements would lead to time-consuming negotiations between the manufacturer and the FAA, and that some flexibility in providing the instructions is necessary. The appendix sets forth, in broad objective terms, the *kinds* of information the Instructions for Continued Airworthiness must contain. Within this framework, the manufacturer would be free to develop detailed instructions appropriate to its aircraft. The FAA is confident that the appendix provides a reasonable measure of flexibility, and anticipates no difficulties or delays in determining the acceptability of the Instructions developed by the manufacturer.

§ *XX.1(b).* A commenter objects to the requirement that Instructions for Continued Airworthiness be provided for appliances, contending that—(1) this information is often not available from the appliance manufacturer; (2) even when available, the information sometimes has to be revised for the particular application in a manner not approved or intended by the appliance manufacturer; and (3) the information necessary for customized equipment installations would be unreasonably costly to develop. The FAA does not agree. Such information, which is essential to the continued airworthiness of the aircraft, should be provided for each required product. Accordingly, the language of § XX.1(b) is revised to make it clear that if the aircraft manufacturer does not supply continued airworthiness instructions for the product, the Instructions for Continued Airworthiness for the aircraft must include this information. See also the discussion under § XX.3(a) (5) (i).

A commenter objects to the proposal to include information on engines and all appliances in the Instructions for Continued Airworthiness, contending that—(1) such information should be furnished by the engine or appliance manufacturer; and (2) with respect to appliances, only those for which standards have been established by FAA should be covered. On the first point, manufacturers of new engine designs are required to supply the information for their products under new § 33.4. Manufacturers of new aircraft using currently certificated engines are required by § XX.1(b) to provide the information for the engine in their Instructions for Continued Airworthiness for the aircraft. In practice, the FAA expects this information to be developed and supplied by the engine manufacturer. A similar requirement for appliances would be administratively impracticable because of the large number involved. On the second point, it should be noted that specific performance and safety standards have not been established for all essential appliances. However, upon further review, the FAA concludes that it would be unreasonable to require the aircraft manufacturer to cover appliances other than those required in applicable regulations. Accordingly, § XX.1(b), as adopted, refers only to appliances "required by this chapter."

§ *XX.2.* A commenter suggests a revision of this section to make clear that the Instructions for Continued Airworthiness may consist of a series of volumes, or may be supplied in other than book form, such as on microfilm or microfiche. The language in § XX.2 is sufficiently broad to cover these acceptable alternatives. Reference to the Air Transportation Association of America Specification No. 100 (where it appeared) is deleted from § XX.2(b) because it is nonregulatory.

§ *XX.3, lead-in paragraph.* A commenter objects to the requirement that the contents of the manual "be prepared to be understood by the persons who will be responsible for maintaining" the aircraft or product, contending that—(1) it would impose a subjective standard that would be impossible to meet; and (2) it could be interpreted to mean that, in some circumstances, manuals for aircraft to be exported must be prepared in the language of the country of export. In light of these comments, the first sentence of the lead-in paragraph of § XX.3, is revised to read as follows: "The contents of the manual or manuals must be prepared in the English language." This conveys the intent of the original proposal. A commenter points out that there may be different levels of maintenance instructions, directed at different classes of operators. For example, the maintenance instructions provided to a fleet operator or commuter airline may be more comprehensive than those provided to a fixed base operator. Any level of maintenance instructions considered appropriate by the manufacturer may be submitted, provided that those instructions comply with the minimum standards in the appendix.

§ *XX.3(a) (2).* A commenter recommends that the requirement for complete descriptions be limited in scope to the "standard" aircraft and "quantity-installed" optional equipment, contending that it would be virtually impossible to devise "custom" maintenance manuals for each product because of the many combinations of equipment that may be ordered by the purchaser. In addition, the commenter states that a manual containing all of these combinations would be difficult to use. The FAA does not agree. To achieve its purpose, the Instructions for Continued Airworthiness must contain information on each item of equipment required by regulation to be installed on the aircraft. The FAA notes that supplemental type certificates (STC's) are required for installation of equipment not a part of the type certificate, and that this maintenance manual requirement is equally applicable to the STC applicant.

§ XX.3(a) (3). A commenter recommends that since maintenance personnel have no need for the kind of operating information provided in a Pilot's Operating Handbook, the paragraph be revised to require only *basic* principles of equipment control and operation. The FAA agrees, and § XX.3(a) (3) now refers to "basic control and operation information."

§ XX.3(a) (5) (i). A commenter recommends that applicants be allowed to refer to a component manufacturer as a source of information instead of including the information in the Instructions for Continued Airworthiness. The commenter argues that many component manufacturers prefer to maintain control of their maintenance information to ensure that it is up to date. In other cases, maintenance at the factory may be required because of the complexity of the equipment. The FAA recognizes that some accessories, instruments, and equipment have an exceptionally high degree of complexity, requiring specialized maintenance techniques, test equipment, or expertise. In such cases, it would be in the interest of safety to allow the applicant to refer to the appropriate manufacturer in the maintenance instructions. The FAA does not agree, however, that such reference should be allowed in other circumstances. Section XX.3(a) (5) (i) (redesignated § XX.3(b) (1)) is revised accordingly.

A commenter recommends that the last sentence of § XX.3(a) (5) (i), be revised to allow reference to a separate inspection program, rather than include it in the maintenance instructions, so that the inspection program could be better kept current and also tailored to an individual operator's needs. The FAA does not agree. The inspection program must be set forth in the Instructions for Continued Airworthiness to ensure its availability to those who will benefit from it.

The FAA, after further study of § XX.3(a) (5) (i), has decided that the provision should specifically require a description of applicable maintenance or wear tolerances. Section XX.3(a) (5) (i) (redesignated § XX.3(b) (1)) is clarified in this regard.

§ XX.3(a) (5) (ii). A commenter objects to the words "could occur" in this paragraph because it encompasses everything within the realm of possibility, thereby unnecessarily increasing the volume of the maintenance instructions. The phrase "probable malfunctions" replaces the phrase "typical malfunctions that could occur" in § XX.3(a) (5) (ii) (redesignated § XX.3(b) (2)).

§ XX.3(a) (5) (iii). A commenter suggests that this paragraph would be clearer if the first three words and the last five words are deleted. Section XX.3(a) (5) (iii) (redesignated § XX.3(b) (3)) is revised accordingly.

§ XX.3(a) (5) (iv). A commenter suggests revision of this paragraph to make it clear that the overweight landing check refers to the condition in which a certificated landing weight is lower than certificated takeoff weight, since the aircraft manufacturer cannot speculate what damage might be done to an aircraft that takes off and must immediately land at a weight near the certificated takeoff weight. This comment may have merit for certain aircraft. Moreover, since an overweight landing is but one of several occurrences which would necessitate a check to determine aircraft damage, to single out one occurrence would imply that the others need not be covered in the maintenance instructions. Accordingly, the words "checks after an overweight landing" are deleted from § XX.3(a) (5) (iv) (redesignated § XX.3(b) (4)).

§ XX.3(b). A commenter recommends deletion of the requirement for an overhaul manual or section, contending that—(1) there are many products that, for safety reasons, should not to be overhauled; and (2) the manufacturer must make the technical assessment as to whether a product can be safely overhauled. In the light of these comments, and after further consideration, the FAA finds that those portions of § XX.3(b) that provide for overhaul information only (except for engines), should not be required in the Instructions for Continued Airworthiness. Accordingly, §§ XX.3(b) (1) (i), XX.3(b) (1) (ii),

XX.3(b) (1) (iv), XX.3(b) (1) (viii), and XX.3(b) (3), are withdrawn. The other provisions of § XX.3(b) specify information that is needed for purposes other than overhaul.

§ XX.3(b) (1) (iii). No adverse comment was received on this proposal to require structural access plate information. Accordingly, it is adopted as proposed, but redesignated § XX.3(c).

§ XX.3(b) (1) (v). No adverse comment was received on this proposal to require instructions on special inspection techniques. Accordingly, it is adopted as proposed, but redesignated § XX.3(d).

§ XX.3(b) (1) (vi). A commenter points out that no part can be restored to its original condition by protective coatings or treatments. The FAA agrees, and § XX.3(b) (1) (vi) (redesignated § XX.3(e)) is revised to make this clear and to require only the information necessary to apply protective treatments to the structure after inspection.

§ XX.3(b) (1) (vii). No adverse comment was received on this proposal to require data on structural fasteners. Accordingly, it is adopted as proposed, but redesignated § XX.3(f).

§ XX.3(b) (1) (ix). No adverse comment was received on the proposal to require a list of special tools. Accordingly, it is adopted as proposed, but redesignated § XX.3(g).

§ XX.3(c). Three commenters object to the concept of supplying generalized repair data. One contended that—(1) the nature of the damage may not be known in a particular case, though it may appear to fall under a general repair "fix"; (2) the safety of the product may be seriously impaired by repairs made in such instances; and (3) the manufacturer can provide alternate means for a mechanic to obtain repair data. In the light of these comments, the FAA agrees that it is not necessary to include the repair information in the Instructions for Continued Airworthiness as proposed. Accordingly, proposed § XX.3(c) is withdrawn.

§ XX.4. A commenter suggests that the manufacturer should be allowed to list items in the Airworthiness Limitations section that it deems necessary to maintain structural integrity, where such items are not called out in the applicable airworthiness standards. Another commenter, representing the scheduled airlines, objects to the inclusion, in the Airworthiness Limitations section, of mandatory replacement times for parts other than life-limited parts and of mandatory inspection intervals. The resolution of these comments is discussed under Proposal 8-3. The language proposed for the Airworthiness Limitations sections of the appendices to Parts 23, 25, 27, and 29 is being retained, except that the mandatory replacement times, mandatory inspection intervals, and related procedures are specified as those associated with structural integrity—including those approved under current § XX.571. It also is made clear that FAA approved alternative programs may be used. To avoid unnecessary restriction being placed on operation, only these items are listed in the pertinent Airworthiness Limitations section. Other items can of course be listed in other sections of the Instructions for Continued Airworthiness.

Proposal 8-26. The addition of new §§ 25.101(i) and (j) would set forth requirements for automatic systems that affect performance, including automatic takeoff thrust control systems (ATTCS). In view of the evolving technology of automatic systems, the special features and functions of each design, and the complex interrelationships with other systems, the FAA has concluded that specific regulations are premature and that safety considerations can be more advantageously addressed in special conditions for specific systems. Accordingly, Proposal 8-26 and related Proposals 8-34, 8-48, and the § 25.1305(c) (9) portion of 8-50 are withdrawn.

Proposal 8-27. The revision of § 25.111(c) (4) will permit changes in power or thrust by an automatic takeoff thrust system but prohibit any change requiring action by the pilot when determining the takeoff path. Although specific proposals relating to criteria for automatic takeoff thrust systems have been withdrawn, the FAA believes that this proposal should be retained as it standardizes the procedure for determining the takeoff path, and is consistent with current practice.

One commenter implies that this rule change will add the task of monitoring conditions and instruments and thereby increase the pilot workload. Other commenters suggest that a limited provision for manual throttle setting be included, or are opposed to the proposal completely on the grounds that safety will be compromised in service. Since the rule will apply in the context of a determination of performance rather than an operating requirement, the proposal is adopted without change.

Proposal 8-28. A commenter suggests that the term "impair" in § 25.253(a) (2) (iii) be changed to "significantly impair". The FAA does not agree. In present high altitude, high Mach number jet airplanes, any recovery from upset or speed anomaly must be done essentially by reference to flight instruments. Therefore, any buffet or vibration condition which would in any way impair the pilot's ability to accurately interpret instrument information cannot be tolerated. The same commenter stated that some interpretative material on vibrational frequencies and levels of acceleration would be useful. Use of interpretative material would divert attention from the primary consideration, impairment of pilot ability, which is qualitative. Proposed § 25.253(a) (2) (iii) is adopted without substantive change.

Proposal 7-17. Although no unfavorable comment was received on the proposal to amend § 25.305(d), two commenters state that their agreement was with the understanding that both the discrete gust and the continuous turbulence analyses are required. Present § 25.341(a) requires that limit load factors be established by reference to a discrete gust encounter. Present § 25.305(d) specifies that the dynamic response of the airplane to vertical and lateral continuous turbulence must be taken into account. Both analyses are required.

Two commenters recommend that present § 25.341 be amended to require dynamic loads analysis by reference to discrete gusts having varying gust gradient distances. The FAA does not agree. The combination of discrete gust analysis under § 25.341 and continuous turbulence analysis under § 25.305 is less complex than the method described by these commenters and provides sufficient substantiation of strength. The proposal is adopted without substantive changes.

Proposal 8-29. Many negative comments were received on the proposal to revise § 25.307(a) to require ultimate load tests for each normal and fail-safe critical load condition. Three commenters indicate that the proposed regulation would add to the cost and time required for certification although present airplane safety records do not support the need for a change. One commenter points out that the design philosophy used for commercial transports, due to the dominant influence of the economic requirement for long life without structural fatigue problems, often produces reserve margins of safety. Another commenter proposes that ultimate load tests be limited to structures such as composites, which substantially differ from conventional structure. The FAA agrees that to conduct ultimate load tests for all critical load conditions would greatly increase the amount of testing required, which is not warranted by the safety record since there have been no service features which indicate that present methods of substantiation are inadequate. In many cases failures in service result from conditions such as fatigue or corrosion which are not covered by ultimate load tests. The proposal to require ultimate testing of all structural components therefore is deleted. In some cases, however, analysis must be supplemented by limit and/or ultimate load tests. The amendment, as adopted, is revised accordingly.

Proposal 8-30. Several negative comments were received on §§ 25.365(e) and (f), requiring airplane designers to consider pressure vessel decompression resulting from the loss of any nonplug door, detonation of a bomb within the cabin at all probable locations, and engine disintegration. Several commenters oppose designing for the loss of a nonplug door, stating that there is no reason why nonplug doors cannot be designed to be as safe as plug doors. These commenters suggest that the door design criteria be upgraded to improve door integrity. The FAA agrees that door integrity should be improved to the extent that design for their loss is not justified. Therefore § 25.783 is revised in response to Proposal 8-35 to require this improved level and § 25.365(e) (1) is withdrawn.

Many commenters object to designing for all possible bomb detonations and probable bomb locations. A commenter points out that airworthiness requirements in the past have attempted to safeguard aircraft against structural and mechanical failure, human error, natural hazards, etc. They note that no one has attempted to incorporate into airworthiness requirements the consequences of homicidal or suicidal tendencies. Another commenter states that the aircraft industry has to accept responsibility for compensating the public for loss or injuries resulting from defects in its products, and the inclusion of a bomb damage requirement in Part 25 could significantly extend the grounds of possible product liability actions, particularly with the imprecise requirements of § 25.365(e). Many commenters state that the wording of § 25.365(e)(3) is so vague as to make its implementation impossible. The FAA notes that, ultimately, minimizing the loss of airplanes as a result of bomb explosions is a ground security problem.

A commenter suggests an alternative to § 25.365(e)(3) which would establish a relationship between the design maximum opening and the cross-sectional area of the pressurized shell. The FAA agrees that the proposed relationship provides an acceptable method for determining hole size. The FAA has determined that the maximum hole size required should be 20 square feet, a value contained in Airworthiness Directive 75-15-05 (August 11, 1975) pertaining to openings in wide-body transports. Section 25.365(e)(3) is revised to allow the maximum opening to vary as a function of the cross-sectional area of the pressurized shell to account for the differences in size between narrow and wide-body transports and is redesignated and adopted as § 25.365(e)(2).

The FAA finds that the maximum opening specified in adopted § 25.365(e)(2) will exceed the opening that would result from causes other than bomb explosions or engine disintegration, and that a probability safety analysis to determine hole size in passenger or cargo areas resulting from other causes is not needed. Thus, proposed § 25.365(f) is withdrawn.

In light of the comments received on proposed § 25.365(e)(4), and after further consideration, the FAA concludes that openings caused by airplane or equipment failure can occur in any compartment, and that partitions, bulkheads, and floors should be designed for openings from these causes. Thus, proposed § 25.365(e)(4) is revised accordingly, redesignated, and adopted as § 25.365(e)(3).

No adverse comments were received on proposed § 25.365(e)(2) to require design to withstand penetration of the cabin by a portion of an engine following engine disintegration and the proposal is redesignated § 25.365(e)(1) and adopted without substantive change.

Amendment to § 25.571(a)(3). Because of the change to § 25.1529 adopted in this amendment, the reference to the "maintenance manual" in § 25.571(a)(3) is no longer appropriate. For consistency, § 25.571(a)(3) references the Airworthiness Limitations section of the Instructions for Continued Airworthiness.

Proposal 8-31. Numerous unfavorable comments were received on the proposal to add a new § 25.633 requiring that essential systems be designed to minimize damage caused by detonation of a bomb in the airplane. Most commenters contend that there is no means to protect essential systems from all possible bomb detonations and that bomb size and location cannot be rationally defined. Several commenters indicate that the separation of essential systems on modern airplanes presently provides a measure of protection and that the proposed requirements of § 25.633 are beyond the state of the art.

The FAA agrees that a rational means of determining and defining all possible bomb size/location combinations which would damage essential systems does not exist. Therefore, the proposal is withdrawn.

Proposal 8-32. Several commenters object to the proposed horizontal stabilizer "trim-in-motion" aural warning requirement of § 25.677(e) on the grounds that the aural environment in today's cockpits is already cluttered and that finding new and distinctive aural warnings is becoming difficult. They further suggest that small increments of trim change should not cause aural warning, and that warnings should be given only when a safety-of-flight hazard exists. One commenter suggests that there is no need for separate aural warning on aircraft having direct trim control wheels in the cockpit.

The FAA agrees with the comments and upon further review concludes that the proposal is premature and unworkable. Accordingly, it is withdrawn for further study.

Proposal 8-33. Several adverse and supporting comments were received on the proposal to add a new § 25.685(e) requiring arrangement of control systems to provide an airplane with the capability of continued safe flight and landing in the event of an inflight localized structural failure. Several commenters agree with the intent of the proposal and propose minor changes. One commenter agrees with the intent of the proposal, but believes that only failures which have not been shown to be extremely improbable need be considered. Commenters state that the intent of the proposed rule change is already encompassed by § 25.365(e) which would require that floor failure resulting from rapid decompression be shown to be extremely improbable.

A commenter further states that present § 25.671(c) requires control systems to be designed to be tolerant of failures, and that control system damage is more likely from other sources. The commenter claims that service experience and rational analysis show that the floor structure provides the best available protection for the control system from damage from these other sources.

After further study the FAA agrees with the commenters that the primary objectives of this proposal are adequately covered by several existing sections of FAR 25. For example: § 25.365(e) requires that the floor be designed for pressure vessel opening which is a function of the cross-sectional area of the fuselage; § 25.571 requires all structure to be damage tolerant where practical; § 25.671 requires that control systems be tolerant of failures, including exterior damage; § 25.629 requires freedom from flutter under failure conditions; § 25.631 requires protection of controls in the empennage structure from bird strikes; and § 25.901(d) requires design precautions be taken to minimize the hazards to the airplane, including control systems, in the event of an engine rotor failure. The proposal therefore is withdrawn.

Proposal 8-34. For an explanation of the withdrawal of the proposals concerning automatic systems that affect airplane performance, one of which is the proposal to add a new § 25.705, see Proposal 8-26.

Proposal 8-35 and 2-59. Several commenters object to the requirement in § 25.783(e) that provisions for the inspection of door locking mechanisms must be discernable under all possible lighting conditions. The commenters state that allowance should be made for use of supplemental lighting such as a flashlight to aid in the inspection. The FAA agrees and the section is revised accordingly.

A commenter states that direct visual inspection is only needed for external doors for which the initial opening movement is not inward and which are pressurized or for which an inadvertent opening could prevent continued safe flight and landing. Although these comments have merit, they go beyond the scope of Proposal 8-35 and interested parties have not had an opportunity to comment on these changes. No change to the section is being made based on these comments. Several commenters object to the redundancy of a dual warning system requirement and state that in lieu of redundancy, a reliability level should be specified. Further comments state that all external doors do not require this level of reliability. The FAA agrees that this reliability level could be specified and should apply only to external doors for which initial movement is not inward, and the section is changed accordingly. The present language defining where door warning systems are required is retained, as no change in present practice is intended.

A commenter suggests that § 25.783(e) should specify several good design practices. These design practices are desirable but are not essential, since the necessary level of safety can be obtained by alternate means under § 25.783.

Several commenters object to new § 25.783(f), suggesting that it apply only to nonplug type doors and doors whose loss would present a probable hazard. The FAA agrees that provisions to prevent unsafe pressurization can be limited to doors whose loss would present a probable hazard. However, the FAA does not agree that it should be limited to nonplug type doors because a plug door is defined as one whose initial opening is inward and this feature does not necessarily provide complete assurance that an unsafe pressurization will not occur with subsequent opening of the door in flight. The clarifying phrase "to an unsafe level" has been added to § 25.783(f). The intent is to prevent pressurization to a level which would be hazardous if an unlocked external door inadvertently opened.

Several commenters object to proposed new § 25.783(g) (Proposal 8-35), stating that it would unnecessarily preclude the use of nonplug type doors above 45,000 ft. The FAA agrees that nonplug type doors can safely be used at altitudes above 45,000 ft., since adequate warning systems and door integrity are provided by § 25.783(e). Proposed new § 25.783(g) is withdrawn.

A commenter proposes that for the door whose opening would be a hazard, the door and immediate surrounding fuselage, door mechanisms, and warning system be designed for any combination of failures (including improper operation) not shown to be extremely improbable. The FAA agrees. In place of the proposals in 8-30, with regard to §§ 25.365(e) (1), (3), and (4), a rule is included to require determination by safety analysis that inadvertent opening of doors which could prevent continued safe flight and landing is extremely improbable.

Two commenters state that the criteria for passenger egress in the revision to the second sentence of § 25.783(g) (Proposal 2-59 of Notice 75-10) should be evacuation time, and not the rate of passenger egress through a given exit. The FAA agrees. Revision of the second sentence of § 25.783(g) is redesignated as § 25.783(i) and the reference to § 25.561(a) (3) in the proposal is corrected to reference § 25.561(b) (3).

Numerous negative comments concern proposed new § 25.783(j), which requires that lavatory doors open into the cabin to preclude anyone from being trapped in the lavatory. The commenters state that this requirement is overly restrictive on design and that an outward opening door could have an adverse effect on aisle width and emergency evacuation capabilities if such a door jammed open. The FAA agrees that inward opening doors can be designed to prevent anyone being trapped in a lavatory in cases of incapacitation or for other reasons. Thus, new § 25.783(j) is revised to delete the requirement that lavatory doors open into the cabin.

Proposals 8-36, 2-60, and 8-37. Final action on Proposals 8-36, 2-60, and 8-37 was taken in Airworthiness Review Program, Amendment No. 8: Cabin Safety and Flight Attendant Amendments (45 FR 7750; February 4, 1980).

Proposal 8-38. One commenter objects to adding a new § 25.792 to require a sign indicating whether lavatories are occupied, asserting that it would be inappropriate for general aircraft certificated under Part 25. Two commenters doubt that the proposed rule would achieve the objective of preventing aisle congestion near lavatories. They point out that many existing aircraft have similar signs which have not prevented people from "standing in line" for lavatories. Also, passengers can cause congestion in aisles for other reasons. One of the commenters states that lighted signs in a darkened cabin; i.e., during movies or rest periods, would annoy passengers, and that the rule might foster a proliferation of signs throughout the cabin. Finally, one commenter is concerned that any increase in the number of lighted signs might distract the passengers' attention from more essential notices.

Based on the comments and upon further review, the FAA finds that the proposed requirement would not achieve the objective sought. Accordingly, the proposal is withdrawn.

Proposal 8-39. Final action on Proposal 8-39 was taken in Airworthiness Review Program Amendment No. 8: Cabin Safety and Flight Attendant Amendments (45 FR 7750; February 4, 1980).

Proposal 8-40. Final action on Proposal 8-40 was taken in Operations Review Program Amendment No. 8 (45 FR 41586, June 19, 1980).

Proposal 8-41. A commenter suggests that new § 25.851(a) (5), which replaces current § 25.853(f), be expanded to prescribe four fire extinguishers for a passenger capacity of 100 or more, and to require at least one CO_2, dry chemical, or all purpose fire extinguisher near lavatory and galley areas. These suggested changes are beyond the scope of the notice. However, changes in these requirements are appropriate and the FAA is conducting a research program to establish comprehensive standards and guidance information pertaining to the selection of portable fire extinguishers, taking into consideration types and quantities of extinguisher agents, extinguisher performance, and other factors. Regulatory changes based on the findings of this research program will be proposed in the next airworthiness standards review.

Sections 25.851(a) (5) and (a) (6), which consolidate hand fire extinguisher requirements, are adopted without substantive change.

Proposals 8-42, 2-18, 2-65, 2-114, and 2-160. Final action on Proposals 8-42, 2-18, 2-65, 2-114, and 2-160 was taken in Airworthiness Review Program, Amendment No. 8: Cabin Safety and Flight Attendant Amendments (45 FR 7750; February 4, 1980).

Proposal 8-43. Final action on Proposal 8-43 was taken in Airworthiness Review Program, Amendment No. 7: Airframe Amendments (43 FR 50578; October 30, 1978).

Proposal 8-44. For a discussion of proposed § 25.905(c), see the discussion under Proposal 8-103. The proposal to add a new § 25.905(c) is adopted without substantive change.

Proposals 8-45 and 8-96. The proposed amendments to §§ 25.939 and 33.65 are being deferred for consideration in a forthcoming notice of proposed rule making of the Aircraft Engine Regulatory Review Program.

Proposals 8-46, 3-35, and 8-47. Final action on Proposals 8-46, 3-35, and 8-47 was taken in Airworthiness Review Program, Amendment No. 7: Airframe Amendments (43 FR 50578; Oct. 30, 1978).

Proposal 8-48. For an explanation of the withdrawal of the proposals concerning automatic takeoff thrust control systems, one of which is the proposal to add a new § 25.1143(f), see Proposal 8-26.

Proposals 8-49 and 3-41. Final action on Proposals 8-49 and 3-41 was taken in Airworthiness Review Program, Amendment No. 7: Airframe Amendments (43 FR 50578; Oct. 30, 1978).

Proposal 8-50. For an explanation of withdrawal of the proposals concerning automatic takeoff thrust control systems, one of which is the addition of a new § 25.1305(c) (9), see Proposal 8-26.

One commenter objects to revising § 25.1305(d) (1), stating that significant aerodynamic forces acting on the powerplant nacelle make the direct measurement of thrust impractical. The FAA agrees that such forces may be significant. This commenter further objects to the revision, stating that it is beyond the state of the art to prohibit a parameter from being used if the accuracy of the indication will be adversely affected by any engine malfunction or damage. The FAA agrees that precise values of thrust provided by a malfunctioning, damaged, or deteriorated engine are unnecessary, provided that any changes in thrust due to engine malfunction, damage, or deterioration are indicated to the pilot. The paragraph is revised to require that the indication must be based on the direct measurement of thrust or of parameters that are directly related to thrust.

Although concurring with § 25.1305(d) (1), one commenter states that he would prefer to retain the existing requirements and delete the words ",or to indicate a gas stream pressure that can be related to thrust,". The FAA does not agree. The change suggested by this commenter would eliminate the requirement for thrust information and would retain the requirement for change-of-thrust information only. It also would provide a lower level of safety than the adopted paragraph.

This commenter also states that § 25.1305(d) (1) should be complementary to a similar requirement in Part 33 of this chapter. The FAA does not agree. In current practice, the airframe manufacturer determines how performance should be met. The choice of a means to indicate thrust is negotiated between the airplane manufacturer and the engine manufacturer. The factors which influence the final choice are substantial and may vary among airplane designs. These factors may not be known to the engine manufacturer at the time of engine type certification. Another commenter states that the need for an actual value of thrust is not obvious, whereas indication of a loss of thrust would satisfy the original proposal. The FAA agrees that the actual value of thrust is of little value to the pilot. Section 25.1305(d) (1) is revised to specify that the indicator indicate thrust, or a parameter related to thrust, to the pilot.

Proposal 8-51. No unfavorable comments were received on the proposal to change the reference in § 25.1307(h) for fire extinguishers in connection with Proposal 8-41. Accordingly, the proposal is adopted without substantive change.

Proposal 8-52. Final action on Proposal 8-52 was taken in Airworthiness Review Program, Amendment No. 8: Cabin Safety and Flight Attendant Amendments (45 FR 7750; February 4, 1980).

Proposal 8-53. Several commenters point out a number of service deficiencies with proposed § 25.1421 which defines the requirements for cargo compartment fire detection systems. They contend that the requirement for the detection system to actuate a warning within one minute of the start of a fire is too restrictive. One commenter cites the results of FAA tests which show average fire detection times to be from 1.75 to 5 minutes. The commenters also suggest that the tests necessary to show compliance with the warning requirements are not clearly defined. Finally, one commenter points out that fires in baggage containers and other enclosed containers can burn for a considerable time before detection is likely by fire detectors in the cargo compartment.

The FAA does not concur that the one-minute requirement is too restrictive. A survey of fire detection technology has indicated that the state of the art permits detection of a fire in less than one minute after inception. In addition, current standards do not define the test procedures necessary to show compliance with warning requirements. The new one-minute requirement is intended to improve the standards in this regard.

The proposal is adopted without substantive change.

NOTE: This proposal has been carried erroneously under § 25.1421 which pertains to megaphones. It will be included in the amendment as a new § 25.858.

Proposal 8-54. Comments received from several commenters reflected confusion over the intent of proposed § 25.1439(c). It was noted that much of what was intended by proposed § 25.1439(c) is included in existing § 25.1439(a) as amended by Amendment 25-38 (41 FR 55454; 12/20/76), provided that the portable oxygen requirements of § 25.1447(c) (4) are retained. Amendment 25-38 emanated from Airworthiness Review Program Notice No. 2 (40 FR 10813; 3/7/75), and was adopted (41 FR 55468; 12/20/76) after publication of Airworthiness Review Program Notice No. 8 (40 FR 29420; 7/11/75) which contained proposals 8-54 and 8-55. The FAA agrees that the existing regulations require much of what was intended by proposal 8-54, provided that proposal 8-55 is withdrawn. The FAA further agrees that additional clarifications are needed before further amendments are made to § 25.1439. Therefore the FAA withdraws both proposals 8-54 and 8-55. The subject of protective breathing equipment will be addressed in a forthcoming notice of proposed rule making.

Proposal 8-55. The proposal to delete § 25.1447(c) (4) is withdrawn for the reasons stated for withdrawal of Proposal 8-54.

Proposal 8-56. For comments related to the proposal to revise § 25.1521(a), and for the withdrawal of that proposal, see Proposal 8-94.

Proposal 8-57. Final action on Proposal 8-57 was taken in Airworthiness Review Program, Amendment No. 7: Airframe Amendments (43 FR 50578; October 30, 1978).

Proposal 8-58. For comments related to the proposal to amend § 25.1529, see Proposal 8-21.

Proposal 8-59. A commenter objects to the proposed new § 25.1557(e), calling for a placard on each flight attendant seat to indicate that it may be occupied by a flight attendant, asserting that such placarding is redundant and that a proliferation of placards in the aircraft will only serve to confuse the passengers and make all placards less effective. The commenter also states that the proposal would prohibit non-flight attendant airline personnel who are cognizant of emergency procedures from occupying flight attendant seats when the aircraft is full. The FAA concludes that a new aircraft certification rule is unnecessary to achieve this result and the proposal is withdrawn.

Proposals 8-60 and 8-61. Final action on Proposals 8-60 and 8-61 was taken in Airworthiness Review Program, Amendment No. 7: Airframe Amendments (43 FR 50578; October 30, 1978).

Proposal 7-55. A commenter recommends that discrete gusts with varying gradient distances be added as a supplement to Appendix G to Part 25. The FAA disagrees because past experience with the use of discrete gusts with varying gust gradient distances has indicated that knowledge with regard to how gust intensity varies with gust gradient distance is not currently available to the designer. The research and development work accomplished in the area of dynamic response to continuous turbulence has indicated that the continuous turbulence criteria of Appendix G to Part 25 is the most rational approach currently available which gives consistent strength levels for airplanes of different characteristics and missions.

A commenter recommends that paragraph (a) of Appendix G be revised to delete the requirement for considering combined stresses based on both vertical and lateral components of turbulence. The commenter states that the current practice of combining root-mean-square stresses (shear, moment, and torsion) resulting from gust calculations involving only purely vertical or lateral components of turbulence is a realistic, practical method for combining stress. The commenter contends that the methods for realistically combining statistical load quantities involving both vertical and lateral components of turbulence have not been satisfactorily developed in the current state of the art. After further review the FAA agrees. Paragraph (a) of Appendix G is revised to delete the requirement for considering the combined stresses resulting from the vertical and lateral components of turbulence.

A commenter recommends that paragraph (b) (3) (i) of Appendix G be revised to require a gust intensity of $U\sigma = 75$ fps gust velocity in the interval 0 to 20,000 ft. altitude with a linear decrease to 30 fps at 80,000 ft. altitude. This recommendation would obviate the need to do mission analysis to justify lower levels of loads than those required to meet the design envelope gust intensity factor of 85 fps for new airplanes whose characteristics are similar to previous designs which have been shown to be adequate for the lower level of gust intensity being proposed. There is no technical need for new aircraft which are similar to existing aircraft with regard to response characteristics and basic mission profiles to make extensive mission analysis computations in order to establish their adequacy with regard to loads resulting from encounters with continuous turbulence if they are designed for the gust intensity shown to be adequate for the existing design. Therefore, it is acceptable to use a gust intensity value of 75 fps from 0 to 20,000 ft. altitude, and a linear reduction from 75 fps at 20,000 ft. to 30 fps at 80,000 ft., provided the new design is comparable to a similar design with extensive satisfactory service experience. These criteria, which have been under discussion between FAA and industry for over 10 years, are proposed as new rules rather than acceptable means of complying with existing rules. Paragraph (b) (3) (i) is revised accordingly. The commenter also recommends that paragraph (d) (1) be revised to require a gust intensity of $U\sigma = 60$ fps on the interval 0 to 20,000 ft. altitude and be linearly decreased to 23 fps at 80,000 ft. altitude. The FAA disagrees. The gust intensities in paragraph (d) (1) are based on the distribution of gust intensity with altitude which were developed in the basic research for the development of continuous turbulence criteria and are, therefore, considered reasonable as a lower design envelope limit for mission analysis. A cost analysis was provided by the commenter to justify the lower gust intensities, but the FAA finds that this cost analysis was based on "design envelope analysis" alone. Paragraph (c), which is an alternative to paragraph (b), provides for a "mission analysis". Actual experience has shown that "mission analysis," which considers airplane operational characteristics, has been used in the past in lieu of the 85 fps intensities to prevent weight and cost penalties. Paragraphs (c) and (d) of Appendix G are adopted without substantive change.

A commenter recommends that paragraph (d) of Appendix G be revised to delete the reference to "fail-safe loads" since such loads are not provided in Appendix G. The FAA agrees. Paragraph (d) of Appendix G is revised accordingly.

A commenter recommends that proposed paragraph (e) of Appendix G be deleted since acceleration levels measured at the pilot station on current conventional aircraft can be established by flight demonstration much more easily and with less cost than by use of an expensive analysis considering response to continuous turbulence. Upon further review, the FAA has determined that it lacks sufficient information to specify the right combination of analysis and flight test to determine the acceleration levels at the pilot's station during continuous turbulence. Accordingly, proposed paragraph (e) of Appendix G is withdrawn. The current requirements related to operation in turbulence are adequate to determine the response at the pilot's station during continuous turbulence.

Proposal 8-62. For comments related to the proposal to add a new Appendix G to Part 25, see Proposal 8-25. Appendix G (redesignated Appendix H) to Part 25 is adopted with the changes discussed in Proposal 8-25.

Proposal 8-63. Final action on Proposal 8-63 was taken in Airworthiness Review Program, Amendment No. 7: Airframe Amendments (43 FR 50578; October 30, 1978).

Amendment to § 27.571. Because of the change to § 25.1529 adopted in this amendment, the reference to § 27.1529(a) (2) in §§ 27.571(b), (c), (d) (1), (d) (3), and (e) is no longer appropriate. The reference is changed to "§ A27.4 of Appendix A". This discrepancy was overlooked in Notice 75-31 (40 FR 29410; July 11, 1975). Since this amendment is clarifying in nature and does not impose a burden on the public, notice and public procedure are unnecessary and good cause exists for adopting this amendment.

Proposal 8-64. For comments related to the proposal to amend § 27.1529, see Proposal 8-21.

Proposals 8-65 and 8-66. Final action on Proposals 8-65 and 8-66 was taken in Airworthiness Review Program, Amendment No. 7: Airframe Amendments (43 FR 50578; October 30, 1978).

Proposal 8-67. For comments related to the proposal to add a new Appendix A to Part 27, see Proposal 8-25. Additional comments on this proposal, and on the proposal to add a new Appendix A to Part 29, are discussed here.

A commenter suggests that the wording of Appendix A be adjusted to take into account the differences between airplanes and rotorcraft. The FAA agrees. The appendix, as proposed, is generally equally applicable to airplanes and rotorcraft. However, several minor changes have been made to the appendix to provide for rotorcraft differences, primarily to cover rotors and differing fatigue standards.

A commenter objects to Appendix A, contending that: (1) The standards in current §§ 27.1529 and 29.1529 have been adequate in service, and (2) the proposal is excessive in scope and would create an undue burden. The FAA does not agree, having found that recommended maintenance procedures made available to operators/owners in the past were frequently inadequate in scope and content, providing no sound basis for maintaining the airworthiness of the rotorcraft. Appendix A, with the revisions and deletions discussed above and under Proposal 8-25, would not create an undue burden on the type certificate applicant.

One commenter expresses concern that certain inspection provisions in current § 91.217 might be applied to rotorcraft. The appendix contains no such requirement. Current § 91.217 applies only to certain airplanes.

Amendment to § 29.571. Because of the change to § 29.1529 adopted in this amendment, the reference to "§ 29.1529(a) (2)" in §§ 29.571(b), (c), (d) (1), (d) (3), and (e) is no longer appropriate. For consistency, the reference is changed to "§ A29.4 of Appendix A required by § 29.1529". This change was overlooked in Notice 75-31 (40 FR 29410; July

11, 1975). Since this amendment is clarifying in nature and does not impose a burden on the public, notice and public procedure are unnecessary and good cause exists for adopting this amendment.

Proposal 2-154. For a discussion directly related to proposed new § 29.783(g), see the discussion under Proposal 8-35 for § 25.783(g) (Proposal 2-59 of Notice 75-10). Section 29.783(g) is adopted without substantive change.

Proposals 8-68 through 8-76 and 2-164. Final action on Proposals 8-68, 8-69, 8-70, 8-71, 8-72, 8-73, 8-74, 8-75, 8-76, and 2-164 was taken in Airworthiness Review Program, Amendment No. 7: Airframe Amendments (43 FR 50578; October 30, 1978).

Proposal 8-77. For comments related to the proposal to amend § 29.1529, see Proposal 8-21.

Proposals 8-78 and 8-79. Final action on Proposals 8-78 and 8-79 was taken in Airworthiness Review Program, Amendment No. 7: Airframe Amendments (43 FR 50578; October 30, 1978).

Proposal 8-80. For comments related to the proposal to add a new Appendix A to Part 29, see Proposals 8-25 and 8-67.

Proposal 8-81. No unfavorable comments were received on adding a new § 31.12 providing for standardized application of the airworthiness requirements for balloons. Accordingly § 31.12 is adopted without substantive change.

Proposal 8-82. No unfavorable comments were received on adding a new § 31.16 requiring that balloon empty weight be determined. Accordingly, § 31.16 is adopted without substantive change.

Proposal 8-83. No unfavorable comments were received on the intent of new § 31.17 which specifies performance in terms of an initial minimum rate of climb. However, a commenter raises the question whether compliance with proposed § 31.17(a) could be shown by testing at several altitudes and ambient temperatures and then extrapolating, by appropriate analysis, to the other values in the range for which approval is sought. The FAA considers that such extrapolation by analysis is an acceptable means of complying with proposed § 31.17(a), because the climb performance of balloons is based on fundamental principles and, therefore, can be predicted with sufficient accuracy from established test points.

The FAA notes that the 300 fpm climb rate requirement in § 31.17(a) was intended as a minimum standard. To make this clear, § 31.17 as adopted is revised by inserting the words "at least" before the number "300" in the first sentence of § 31.17(a).

Proposal 8-84. A commenter, referring to new § 31.19(a) governing critical uncontrolled descent, suggests that it would be difficult and time-consuming to determine which tear is the most critical single tear in the balloon envelope between tear stoppers. The FAA does not agree. An analysis, or a combination of test and analysis, would be an acceptable means of determining the most critical single tear. It would not be necessary to test each kind of tear. No other unfavorable comments were received on the proposal to add a new § 31.19. Accordingly, § 31.19 is adopted without substantive change.

Proposal 8-85. No unfavorable comments were received on the proposal to amend § 31.27(c) to be consistent with new § 31.19, Performance: Uncontrolled descent. Accordingly, the proposal is adopted without substantive change.

Proposal 8-86. No unfavorable comments were received on the proposal to amend § 31.65 updating the position light standards and expressing them in language consistent with related standards in other airworthiness parts. However, the FAA finds that the use of a cross reference to § 23.1397 as proposed in § 31.65(e) may be inconvenient for those governed by Part 31. Accordingly, § 31.65, as adopted, sets forth the chromaticity coordinates for aviation red and aviation white as currently prescribed in § 23.1397.

Proposal 8-87. No unfavorable comments were received on the proposal to amend § 31.71. However, after further consideration, the FAA concludes that proposed § 31.71(a) (2) is unnecessarily restrictive in that it would, in all cases, require marking the equipment as to its identification, function, *and* operating limitations. Marking of the equipment as to its identification, function, *or* operating limitations, or any applicable combination of those factors is sufficient. This is also the language used in corresponding sections of other aircraft airworthiness regulations. Section 31.71, as adopted, is revised accordingly.

Proposal 8-88. No unfavorable comments were received on the proposal to amend § 31.81 to detail operating limitations and information. The FAA notes, however, that proposed § 31.81(b) is not clear as to which "operating limitations and other information necessary for safe operation" must be furnished. The FAA's intent, as stated in the explanation, is to require that the information established under § 31.81(a) be furnished. Section 31.81(b) is revised accordingly. Section 31.81(a) is adopted without substantive change.

Proposal 8-89. A commenter is concerned that proposed § 31.82 might require balloon manufacturers to prepare two overlapping maintenance documents—the maintenance manual currently supplied to operators/owners, and the proposed Instructions for Continued Airworthiness. The FAA notes that under §§ 31.82 and 21.50(b), balloon manufacturers would be required to prepare and furnish only the Instructions for Continued Airworthiness.

The FAA notes further (as discussed under Proposal 8-21) that the Instructions for Continued Airworthiness need not be finalized until delivery of the first balloon, while § 31.82, as proposed, could be interpreted to require that they be finalized before type certification. This point is clarified in § 31.82, as adopted, consistent with the corresponding requirement in Parts 23, 25, 27, and 29.

Proposal 8-90. No unfavorable comments were received on the proposal to amend § 31.85(b) (1). However, a commenter questions whether percentage figures on the required fuel quantity gauge would be acceptable. The FAA has determined that, in the particular case of balloons (for which the fuel quantity information is to an extent less important to safety than for other classes of aircraft), calibration of the fuel quantity gauge in percent of fuel cell capacity is an acceptable means of complying with the last sentence of § 31.85(b) (1). Section 31.85(b) (1), as adopted, is revised to make this clear.

Proposal 8-91. No adverse comments were received on the proposal to add a new Appendix A to Part 31. However, comments received on the proposals to add a similar appendix to Parts 23, 25, 27, and 29 (Proposal 8-25), were equally valid with respect to this proposal. Accordingly, Appendix A to Part 31, as adopted, is revised in substance as applicable.

Regarding the proposals to require generalized repair data in the Instructions for Continued Airworthiness, it is more appropriate, as well as necessary and practicable, to include specific instructions for repair of the key elements of a balloon—the balloon envelope and its basket or trapeze. This information is incorporated in paragraph A31.3(i) as revised.

Proposal 8-92. A commenter objects to § 33.4 insofar as it would require completion of the Instructions for Continued Airworthiness before the type certificate is issued, contending that a significant portion of the data and other material called for is typically not compiled until 6 months or longer after type certification. The commenter suggests that manufacturers be allowed to prepare and make available the Instructions for Continued Airworthiness before the first aircraft equipped with the subject engine is put into service, which, it claims, is the earliest such instructions would be needed. Requiring the engine manufacturer to complete the Instructions for Continued Airworthiness before the type certificate is issued would constitute an unnecessary burden. However, the FAA considers that they must be made available, and furnished, upon delivery of the first engine on an aircraft or issuance of a standard certificate of airworthiness for the aircraft, whichever occurs later. This would be consistent with corresponding requirements proposed for other products. See Proposals 8-5 and 8-21. Section 33.4 is revised and adopted accordingly.

Proposal 8-93. A commenter observes that § 33.5 requires that the instruction manual for installing and operating the engine be "approved," whereas proposed § 33.4 requires that the Instructions for Continued Airworthiness be "acceptable to the Administrator," and recommends that the latter term be used for consistency. The FAA notes that the term "acceptable to the Administrator" is widely used in Part 43 in connection with maintenance requirements, whereas the term "approved" is more frequently used in FAR Parts containing installation and operating requirements. Considering the FAR as a whole, the FAA does not agree that such consistency is essential. Accordingly, § 33.5 is adopted as proposed.

Proposal 8-94. Several commenters object to proposed §§ 33.6(e) and (f), and to proposed §§ 23.1521(a) and 25.1521(a) (Proposals 8-20 and 8-56, respectively) on the grounds that the use of rated takeoff power or thrust for 10 minutes with one engine inoperative should not be limited to "the extent that the utilization is necessary for the airplane to avoid, without necessitating turning maneuvers, obstacles beneath the flight path intended for the airplane prior to the loss of the engine." In light of these comments and after further review, the FAA concludes that these proposals are premature and they are withdrawn.

In addition, the proposed transfer of the definitions for rated power and thrust from § 1.1 to proposed new § 33.6, Proposal 8-1, is withdrawn since the transfer may cause confusion in the administration of the aircraft certification requirements. Accordingly, Proposals 8-1, 8-20, 8-56, and 8-94 are withdrawn.

Proposal 8-95 For discussion of proposed § 33.19(b) see the discussion under Proposal 8-103. Revised § 33.19 is adopted without substantive change.

Amendment to §§ 33.55(c), 33.57(b), 33.93(b), and 33.99(b). Because of the deletion of §§ 33.5(c), (d), and (e), and the addition of a new § 33.4, the reference to "§ 33.5" in §§ 33.55(c), 33.57(b), 33.93(b), and 33.99(b) is no longer appropriate. For consistency, the reference is "§ 33.4." This change was inadvertently overlooked and was not proposed in Notice 75-31 (40 FR 29410; July 11, 1975). This editorial change corrects that discrepancy. Since this amendment is clarifying in nature and does not impose a burden on the public, notice and public procedure are unnecessary and good cause exists for adopting this amendment.

Proposal 8-97. A commenter recommends that § A33.3(a) (6) of Appendix A to Part 33 be revised by adding the words "requiring periodic attention" so as to make it clear that scheduling information is required solely for parts that require such attention. The language in this section is adequate. For parts not needing periodic attention, the applicant has only to state that parts not scheduled need not be serviced.

A commenter infers incorrectly that proposed §§ 43.16 and 91.163(c) apply only to rotorcraft. These regulations with the revision proposed also affect other classes of aircraft, as well as engines and propellers.

Some comments received on the proposed appendices for Parts 23, 25, 27, and 29 (Proposal 8-25) were equally valid with respect to proposed Appendix A to both Parts 33 and 35. Accordingly, the appendices to Parts 33 and 35 are revised in substance as applicable.

Proposal 8-98. For a discussion related to proposed § 35.3 see Proposal 8-93. A commenter observes that § 35.3 requires that the instruction manual for installing and operating the propeller be "approved," whereas § 35.4 requires that the Instructions for Continued Airworthiness be "acceptable to the Administrator," and recommends that the latter term be used for consistency. The FAA notes that the term "acceptable to the Administrator" is widely used in Part 43 in connection with maintenance requirements, while the term "approved" is more frequently used in FAR parts containing installation and operating requirements. Considering the FAR as a whole, the FAA does not agree that consistency is required in this instance. Accordingly, § 35.3 is adopted as proposed.

Proposal 8-99. In response to the concern of a commenter representing a number of Part 121 operators, the FAA notes that there is no requirement that any operator/owner use the Instructions for Continued Airworthiness referred to in proposed § 35.4. The new §§ 43.13(a), 43.16, and 91.163(c) allow the use of other methods. In particular, the use of maintenance manuals and continuous airworthiness maintenance programs developed under Parts 121, 123, 127, and 135, or an inspection program approved under § 91.217(e) would be acceptable alternatives to the Airworthiness Limitations section. This commenter suggests that language be added to proposed § 35.4 to make it clear that such alternatives may be used. The FAA agrees. The language in §§ 43.16 and 91.163(c) is revised accordingly.

Consistent with the discussion on proposed § 33.4 dealing with engines (see Proposal 8-92), the FAA finds that requiring the propeller manufacturer to complete the Instructions for Continued Airworthiness before the type certificate is issued would constitute an unnecessary burden. Accordingly, § 35.4 as adopted, requires that those instructions be made available and furnished upon delivery of the first aircraft with the propeller installed, or upon issuance of a standard certificate of airworthiness for an aircraft with the propeller installed, whichever occurs later.

Proposal 8-100. No unfavorable comments were received on the proposal to amend § 35.5 to more clearly indicate the basis for operating limitations and where they are listed. Accordingly, § 35.5 is adopted without substantive change.

Proposal 8-101. No unfavorable comments were received on the proposal to amend § 35.23 to provide an extreme low pitch indication. Accordingly, § 35.23 is adopted without substantive change.

Proposal 8-102. A commenter does not concur with the proposal to revise § 35.37 to require evaluation of metallic hubs and blades, stating that the words "must", "all", and "reasonably foreseeable" in the second sentence imply responsibility beyond current knowledge and the state of the art. The FAA does not agree. These terms are used in the current rule and the current state of the art defines the limits of the provision.

The same commenter recommends that § 35.37 be revised to apply to consideration of "normal and reasonably foreseeable load patterns," to account for the fact that only normal operations will or should be considered. The FAA does not agree. Load patterns which are reasonably foreseeable are critical and should be investigated even if they are not normal.

The same commenter also indicates that the third sentence should be revised to eliminate the term "reduction factors," since reduction factors are identified with only one particular method of presentation. The FAA agrees and the section is revised accordingly. This commenter finally states that the explanation implies that manufacturers have not taken permissible damage and material variation into account. This implication is not intended. It is the FAA's view that the fatigue evaluation should consider the occurrence of typical service damage and variation in material properties and the rule would provide for such an evaluation.

Another commenter suggests that the section be revised by adding certain technical requirements that are related to infinite component life. It is not necessary to specify requirements concerning infinite component life, since they are considered a normal part of propeller fatigue testing.

Section 35.37 is adopted as revised.

Proposal 8-103. A commenter objects to the proposal to add a new § 35.42 to define durability requirements for propeller blade pitch control system components, stating that the term "bench tests" in §§ 35.42(a) and (b) is too descriptive and restrictive. The FAA agrees that a reference to "bench tests" may be too restrictive. Other test methods may be equally acceptable in providing the necessary data. Accordingly, §§ 35.42(a) and (b) are revised to eliminate the specific reference to "bench."

The commenter also suggests that the words "in frequency and amplitude" be eliminated from § 35.42(a) since the words "cyclic testing" are fully descriptive. The FAA believes that these words are needed to prescribe key elements in the required test.

The commenter further suggests that the proposed testing to the equivalent of 1,000 hours of propeller operation is too restrictive in the case of a propeller with an overhaul period of less than 1,000 hours. The FAA considers the specific testing to be the minimum necessary to provide an acceptable safety level in service. The rule does not, however, prevent the selection of overhaul intervals of less than 1,000 hours.

Finally, the commenter suggests that the rule should permit an alternate of acceptance based upon service experience. The FAA recognizes that service experience can provide a statistical basis for determining component reliability. Its applicability, however, may vary according to such considerations as type of operation, the nature of the article under consideration, the degree of similarity between the reference article and the certification article, and the completeness of service records. Since it is dependent on such a variety of factors, the FAA does not agree that a specific alternative based on service experience should be included.

The proposal to add a new § 35.42, therefore, is adopted with the change discussed below. No adverse comments were received on the related proposed revisions to §§ 23.905, 25.905, and 33.19 to add the reference to new § 35.42, and the revisions are adopted.

Proposal 8-104. For comments related to the proposal to add a new Appendix A to Part 35, see Proposals 8-25 and 8-97.

A commenter objects to proposed § A35.1(c) of the appendix because the propeller owner (aircraft operator) would be wastefully provided with instructions and data that the propeller owner has no authority to use. The FAA does not agree. The Instructions for Continued Airworthiness must be furnished to the aircraft owner/operator who is the person responsible for maintaining the aircraft (including the propeller). The owner/operator may not be authorized to maintain the propeller, but the owner/operator can place the instructions in the hands of persons who are authorized.

The new Appendix A to Part 35, as adopted, is revised in accordance with comments discussed in Proposal 8-97.

Proposal 8-105. The proposed revision of § 43.9(a)(4) is being deferred for consideration in a forthcoming notice of proposed rule making of the Operations Review Program.

Proposal 8-106. A commenter representing a number of scheduled air carriers is concerned that the use of maintenance manuals and continued airworthiness programs developed under current § 121.133 and Subpart L of Part 121 (generally via Maintenance Review Board procedures), or under similar provisions of Parts 127 and 135, might not be acceptable as "other methods, techniques, and practices" under the terms of proposed § 43.13(a). This commenter suggests that language be added to proposed § 43.13(a) to make this clear. The FAA does not agree. The proposed language states that the use of such manuals and continued airworthiness programs is acceptable.

Proposal 8-107. A commenter representing a number of scheduled air carriers recommends that the Airworthiness Limitations section referred to in proposed § 43.16 include life limitations only and not inspections or other maintenance items. As discussed under Proposal 8-3, the FAA does not agree.

A commenter suggests that the words "or other methods, techniques; and practices acceptable to the Administrator" be added at the end of proposed § 43.16 to make it consistent with proposed § 43.13(a). The Airworthiness Limitations section contains specific mandatory replacement times and inspection intervals (with related procedures) that must be complied with, unless it can be shown by an operator with an approved maintenance program that these times are inappropriate for his operation. The use of alternatives not covered in the Airworthiness Limitations section would be allowed if approved by the Administrator. Section 43.16 is revised to specifically state the alternatives to compliance with the Airworthiness Limitations section.

Proposal 8-108. No unfavorable comments were received on the proposal to amend § 45.11 to qualify, with respect to manned free balloons, the requirements in § 45.11(a) that deal with the location of the identification plate. Accordingly, the proposal is adopted without substantive change.

Proposal 8-109. No unfavorable comments were received on the proposal to amend § 45.13 to correctly reference §§ 45.11(a) and (b) with regard to identification plate requirements. Accordingly, the proposal is adopted without substantive change.

Proposal 8-110. A commenter representing a number of scheduled air carriers recommends that the words "inspection interval, or related procedure" be deleted from proposed § 45.14. The supporting rationale is the same as submitted by this commenter concerning Proposal 8-3 to amend § 21.31(c). As discussed under Proposal 8-3, the FAA disagrees.

The language in § 45.14 covers rotorcraft as well as airplanes, balloons, engines, and propellers. To make this clear, the word "Rotorcraft" is changed to "Manufacturer's".

Two commenters object to proposed § 45.14 on the grounds that it would be impracticable to mark small parts with a part and serial number. The FAA is not aware that the marking of small parts under current § 45.14 has presented a problem. In any event, the rule allows markings that are equivalent to part and serial numbers, such as symbols enabling the identification of the part as one for which a replacement time, inspection interval, or related procedure is specified in an Airworthiness Limitations section. Identification of such parts is clearly essential for safety. Accordingly, § 45.14 is adopted as revised.

Proposal 8-111. A commenter representing a number of scheduled air carriers recommends that the words "inspection interval, or related procedure" be deleted from proposed § 91.163(c). The supporting rationale is the same as that submitted by this commenter concerning Proposal 8-3 to amend § 21.31(c). As discussed under Proposal 8-3, the FAA disagrees. However, § 91.163(c) is revised to specifically identify the acceptable alternatives to compliance with the "Airworthiness Limitations" section.

The language in proposed § 91.163(c) covers rotorcraft as well as airplanes, balloons, engines, and propellers. To make this clear, the word "Rotorcraft" in § 91.163(c) has been changed to "Manufacturer's", and a statement has been added that operations specifications approved by the Administrator may be used in lieu of the Instructions for Continued Airworthiness. Section 91.163(c) is adopted as revised.

Proposal 8-112. No unfavorable comment was received on the proposal to amend § 91.165 to clarify maintenance personnel entries in maintenance records. Accordingly, the proposal is adopted without substantive change.

Proposal 8-113. Several commenters object to §§ 91.173(a)(2)(i) and (iii). A commenter states that adoption of the proposal would result in an inconsistency between § 91.173 and § 121.380, which contains the recordkeeping requirements for aircraft maintained under Part 121. The commenter also states that this inconsistency would cause great difficulty and economic hardship whenever an aircraft is sold by a Part 121 operator to a Part 91 operator and the Part 91 aircraft is maintained by a Part 121 operator under its repair station certificate. According to the commenter, the economic hardship would occur to both the Part 91 operator and the repair station. The same commenter contends that reliability information accumulated in recent years on transport category airplanes shows that there is no need for individualized total time records on equipment and components. Another commenter states that proposed requirements would result in large increases in maintenance costs for Part 91 operators and that only those components that are life-limited should have to carry total times.

The FAA concludes, however, that revision of § 91.173(a)(2)(i) would contribute significantly to safety with little burden on those affected. The currently prescribed record of total time in service for the airframe does not generally apply to the aircraft's engines or propellers, since these components are frequently overhauled (or replaced) at different times. As a practical matter, it is known that operators of such aircraft normally keep records from which the total time in service of engines and propellers can be derived. Therefore, the FAA does not agree that the requirement to keep total times on engines and propellers would be a hardship and burden upon the operators. Accordingly, § 91.173(a) (2) (i) is adopted without change.

In light of the comment on proposed § 91.173(a) (2) (iii), the FAA has given further review of the proposal and has concluded that existing requirements satisfy the objective of the proposal. Accordingly proposed § 91.173(a) (2) (iii) is withdrawn.

The reporting and recordkeeping requirements contained in § 91.173 have been approved by the Office of Management and Budget in accordance with the Federal Reports Act of 1942.

Proposal 8-114. Several commenters agree with the intent of proposed § 91.193(c) (4) but suggest changes. A commenter suggests that the proposed installation instructions for hand fire extinguishers would be more appropriately placed in the type certification rules. The FAA does not agree. New type certification rules do not apply to aircraft already in service.

A commenter suggests that the words "unless obvious" be added to clarify when the hand fire extinguisher stowage provisions must be properly identified. The FAA agrees. Proposed § 91.193(c) (4) is revised and adopted accordingly.

Proposal 8-115. One commenter objects to the proposal to revise § 91.197(a) to require passenger information signs to meet the requirements of § 25.791. The commenter states that it is unnecessary, in many small general aviation aircraft operating under Subpart D of Part 91, to have such signs just for the sake of uniformity. The commenter also states that "nonstandard" signs now in use are wholly adequate to meet the needs of the type of operation. Finally, the commenter points out that installation costs for aircraft not currently having signs would be high and the pilot could just as easily announce the information as he could activate the signs.

Based on these comments and considering the type of operation involved, the FAA finds that the benefits associated with the proposal do not warrant its adoption. The proposal to revise § 91.197(a) is withdrawn.

Proposals 8-116, 8-117, 8-118, and 8-119. Final action on Proposals 8-116, 8-117, 8-118, and 8-119 was taken in Airworthiness Review Program, Amendment No. 8: Cabin Safety and Flight Attendant Amendments (45 FR 7750; February 4, 1980).

Proposal 8-120. In light of the need to conduct further testing of protective breathing equipment, the FAA withdraws its proposal to amend § 121.337, which will be addressed in an upcoming notice of proposed rule making.

ADOPTION OF THE AMENDMENT

Accordingly, Parts 11, 21, 23, 25, 27, 29, 31, 33, 35, 43, 45, and 91 of the Federal Aviation Regulations are amended, effective October 14, 1980.

(Sections 313(a), 601, 603, and 604 of the Federal Aviation Act of 1958 (49 U.S.C.1354(a), 1421, 1423, and 1424)); and Section 6(c) of the Department of Transportation Act (49 U.S.C.1655(c)))

The FAA has determined that this document involves a regulation which is not significant under Executive Order 12044, as implemented by Department of Transportation Regulatory Policies and Procedures (44 FR 11034; February 26, 1979). A copy of the final evaluation prepared for this document is contained in the docket. A copy of it may be obtained by writing to the individual and address listed in the "For Further Information Contact" paragraph.

Amendment 27-19
Rotorcraft Regulatory Review Program; Amendment No. 1

Adopted: January 6, 1983 **Effective: March 2, 1983**

(Published in 48 FR 4374, January 31, 1983)

SUMMARY: This rule adopts airworthiness standards for type certification of normal and transport category rotorcraft. It revises the applicability of Part 29 and incorporates standards for instrument flight rule (IFR) and icing certification in both Parts 27 and 29. This revision establishes a clear relationship between the number of passenger seats and the required performance level for transport category rotorcraft. For cargo configurations and configurations of less than 10 passengers, the rule relaxes requirements in the areas of height-velocity and maximum weight and will result in increased productivity for roles which are special and unique to rotorcraft. This change also adopts IFR standards for rotorcraft handling qualities and systems design with minor revisions from the current requirements which have been successfully administered for a number of years through IFR interim standards. The icing standards which are adopted by this change incorporate the same natural environment recognized in Part 25 transport airplane rules for many years, and provide considerable flexibility for demonstrating safe flight capability. This amendment affects only new civil rotorcraft models for which an application for a new type certificate is received after the adoption of the rule. The existing rotorcraft certification rules have not undergone a comprehensive reassessment in over 25 years. In the intervening period, significant improvements in rotorcraft capabilities have been made and rotorcraft usage has evolved somewhat differently than that originally envisioned. The Rotorcraft Regulatory Review Program was initiated at the request of industry. This amendment, which is the result of an extensive review of rotorcraft certification requirements by industry and Government, updates the existing rules to recognize these improvements, current uses, current technology, and future projections. The rule provides increased safety benefits to passengers traveling in rotorcraft. A thorough assessment of potential benefits and burdens has been made in accordance with Executive Order 12291. It has been judged that the benefits of this amendment, in providing an increased level of safety to passengers traveling in rotorcraft while at the same time recognizing and providing for the unique qualities and capabilities of rotorcraft, far outweigh the burdens.

FOR FURTHER INFORMATION CONTACT: Tommie S. Plummer, Regulations Program Management (ASW-111), Aircraft Certification Division, Mailing Address: P.O. Box 1689, Fort Worth, Texas 76101 and office location at 4400 Blue Mound Road, Fort Worth Texas 76106, telephone (817) 624-4911, ext. 504.

SUPPLEMENTARY INFORMATION:

Discussion of Comments

§ 29.1 Applicability

All changes in applicability of the rule are contained in revised § 29.1. However, this change influences other portions of the current rule which may be summarized in the following three areas:

(1) Transport category rotorcraft certificated with 10 or more passenger seats must comply with the category A design requirements of Subparts C, D, E, and F of Part 29 and the category A final segment climb requirement of § 29.67(a) (2). (2) In Part 29, height-velocity (HV) is removed as an operating limitation for category B rotorcraft with nine or less passenger seats. HV information for these models must be placed in the performance section of the Rotorcraft Flight Manual. (3) In Part 29, the 20,000-pound weight limit for category B is removed for rotorcraft with less than 10 passenger seats.

This adopted applicability rule is the same as that in Notice 80-25 with the exception of relaxed requirements for 10 or more passenger rotorcraft having a maximum certificated weight of 20,000 pounds or less. The proposal in Notice 80-25 would have required rotorcraft with 10 or more passengers to be fully certificated to category A standards of design and performance. To attain full category A performance capability, future rotorcraft would have been required to incorporate additional power with resultant higher cost. The FAA, in Notice 80-25, estimates this cost at $12.5 million over the first three years of production for each new model in this range of weight and passenger seating. One commenter estimates a $1.35 billion impact on the total world economy over a 5-year production period for all affected models. Another commenter estimates a $1 billion impact for the world market in a similar 5-year period. While these economic analyses should have included only the impact on the U.S. economy, and the impacts were not calculated in a manner similar to that in which a new model would enter the market, the impact is nevertheless significant. Additional clarifying data were obtained from these commenters and were docketed to allow the FAA to more accurately assess the economic impact of this proposal. This additional information was of great benefit to the FAA. Discounting the previously mentioned features of the commenters' analyses and eliminating certain double counting of purchase price increases, the FAA estimates that the economic impact on the U.S. economy of providing full category A capability for 10 or more passenger configurations would be $1.18 billion over the first 10 years of production. This 10-year production period would begin approximately 5 years after adoption of the proposed rule.

While the concept of full category A protection for 10 or more passengers is a worthwhile goal which FAA hopes will be ultimately achieved, the safety benefits are difficult to quantify through existing accident statistics and, therefore, do not appear to clearly outweigh the cost as required by Executive Order 12291.

The significant cost impact in this portion of the proposed rule was alleviated by requiring only a portion of the category A performance requirements. The existing requirement in § 29.67(a) (2) for category A final segment climb has been adopted instead of the full category A performance package. This change alleviates the large one-engine-inoperative (OEI) power requirements needed when an engine fails at low speed, yet the change retains category A performance capabilities throughout a large portion (climb, cruise, and descent) of the flight regime. It is realized that in many cases the traveling public associates twin-engine helicopters with the capability to continue flight when an engine fails. The performance requirement adopted in this rule will assure that capability for 10 or more passenger configurations in only a portion of the flight envelope; nevertheless, it is considered a significant increase in the minimum performance level for certification of civil rotorcraft. At the same time, it must be recognized that engine-out performance capability will not be assured during takeoff or landing at low-speed conditions from hover to near-best rate-of-climb speed. FAA is encouraged by the increases in power-to-weight which have resulted from technological changes over the last 15 years in transport category rotorcraft, and it is hoped that increased technology will ultimately lead to full category A performance capability for these transport category designs.

Six commenters made docket submittals on applicability. One commenter fully supports the proposed applicability change. This commenter states that a review of safety records found the fatal accident rate of transport helicopters to be significantly higher than that of comparable fixed-wing transport aircraft. The commenter states that "the attainment of a high level of airworthiness in fixed-wing transports has been, in part, achieved by means of high standards of reliability and the provision of redundancy in aeroplane design, and there is no reason why similar approaches to the design of helicopters should not be adopted. . . ." FAA agrees with these comments and this "fail safe" concept for transport rotorcraft is partially addressed through the category A provisions of this rule. Other design aspects of this comment were outside the scope of Notice 80-25. These additional aspects will be considered in aircraft systems, powerplants, and structures areas for incorporation in future notices under this Rotorcraft Review Program.

A second commenter recommends a separate FAR part for utility helicopter certification rules and recommends incorporating standards similar to those proposed in Notice 80-25 for transport category B. This comment is considered outside of the scope of Notice 80-25. The second commenter also recommends retaining height-velocity as a limitation for category B, but having it mandatory only when carrying passengers. This comment is more properly an operating consideration and will be addressed in a later notice as part of this review.

A third commenter recommends that the category A design standards currently in Subparts D, E, and F of Part 29 be required for 10 or more passengers. This commenter argues that many multiengine helicopters recover "category A performance" in cruise conditions, and that certification to the "category A, technology" of Subparts D, E, and F offers a sufficient level of safety for transport category rotorcraft carrying more than nine passengers. The recommendations of this commenter regarding category A design standards have been considered and are adopted as a portion of the applicability rule.

The remaining three commenters oppose the category A requirement for 10 or more passengers on the basis that added safety benefits do not offset the large costs of full category A performance. One of these commenters strongly supports removing the category B, 20,000-pound weight limit, but feels that this group of rotorcraft should be allowed to carry large numbers of passengers. Another commenter proposes retaining the present 20,000-pound category B weight limit and requiring all multiengine rotorcraft to incorporate full category A design features. This commenter's proposal could have significant adverse impacts on future large helicopter designs similar to a recently certified configuration in the 50,000-pound weight class, which can show an increase in payload of approximately 12,000 pounds under category B performance standards for missions such as transporting oil drilling or exploratory equipment into inaccessible, confined areas. It would also unnecessarily restrict those small-scale applicants engaging in aircraft alteration who may wish to replace a large engine with two smaller engines and continue to certify a helicopter to category B performance standards. The commenter's proposal could be reasonably met by an original manufacturer, but does not treat the small-scale applicant equally because that applicant would not typically have the capability to fully redesign rotorcraft systems to category A standards. Single-engine category B rotorcraft are designed with suitable flight characteristics and sufficient rotor inertia to safely tolerate total power failure. For single-engine rotorcraft which are modified to incorporate a twin-pack or an additional engine, the remaining category A isolation features are not needed to assure freedom from total power failure because that condition has already been safely substantiated for the design. For FAA to require full category A design for this condition as its minimum safety standard would impose a crippling economic burden which is not warranted.

At the same time, however, these category B designs are not considered appropriate for transporting large numbers of passengers. In Notice 80-25, the manufacturers' and operators' responsibilities to protect large numbers of people were explained in some detail. Current certification rules differentiate between levels of design by rotorcraft weight only. It is necessary and appropriate for minimum safety standards to be clearly related to the number of persons affected. The philosophy behind this rule is that the higher the potential level of danger and the more people who fall within the endangered class, the higher the level of safety should be. The greater the number of passengers, the greater the potential loss of life in an accident; the greater the size and inertia of an aircraft, the greater the potential hazard to persons on the ground in the event of an accident. These two features, size and number of passenters, combine to determine the level of safety required by this rule.

Three commenters question the need for category A performance due to the lack of engine failure accident statistics in multiengine category B rotorcraft. One commenter states that the FAA does not recognize the safety record of large multiengine category B helicopters. FAA accident statistics show an impressively low number of accidents due to engine-related failures in multiengine category B rotorcraft. Approximately 30 percent of all rotorcraft accidents over the past several years have been related to engine failure. In multiengine rotorcraft, only about 10 percent of the accidents have been related to engine failure. This is due, in part, to the fact that at moderate weights and low-density altitudes, many current category B twin-engine rotorcraft have performance capabilities equivalent to category A standards throughout a significant portion of their operating envelope. Many engine failures have not become accident statistics due to this one-engine-inoperative performance capability. These FAA accident statistics serve even more clearly to highlight the need to prohibit future single-engine rotorcraft designs from carrying 10 or more passengers. During the period from 1966 to 1979, there were 44 accidents in twin-engine helicopters carrying 10 or more passengers. Of those accidents, 9 percent were related to engine failure. During that same period there were 81 accidents in single-engine rotorcraft carrying 10 or more passengers. Of those accidents, 33 percent were related to engine failure. The FAA determined that up to eight of these accidents may have been prevented through the multiengine, category A requirements of this rule. Upgrading the requirement for rotorcraft with 10 or more passenger seats to the multiengine category A configuration establishes an appropriate level of safety for civil certification.

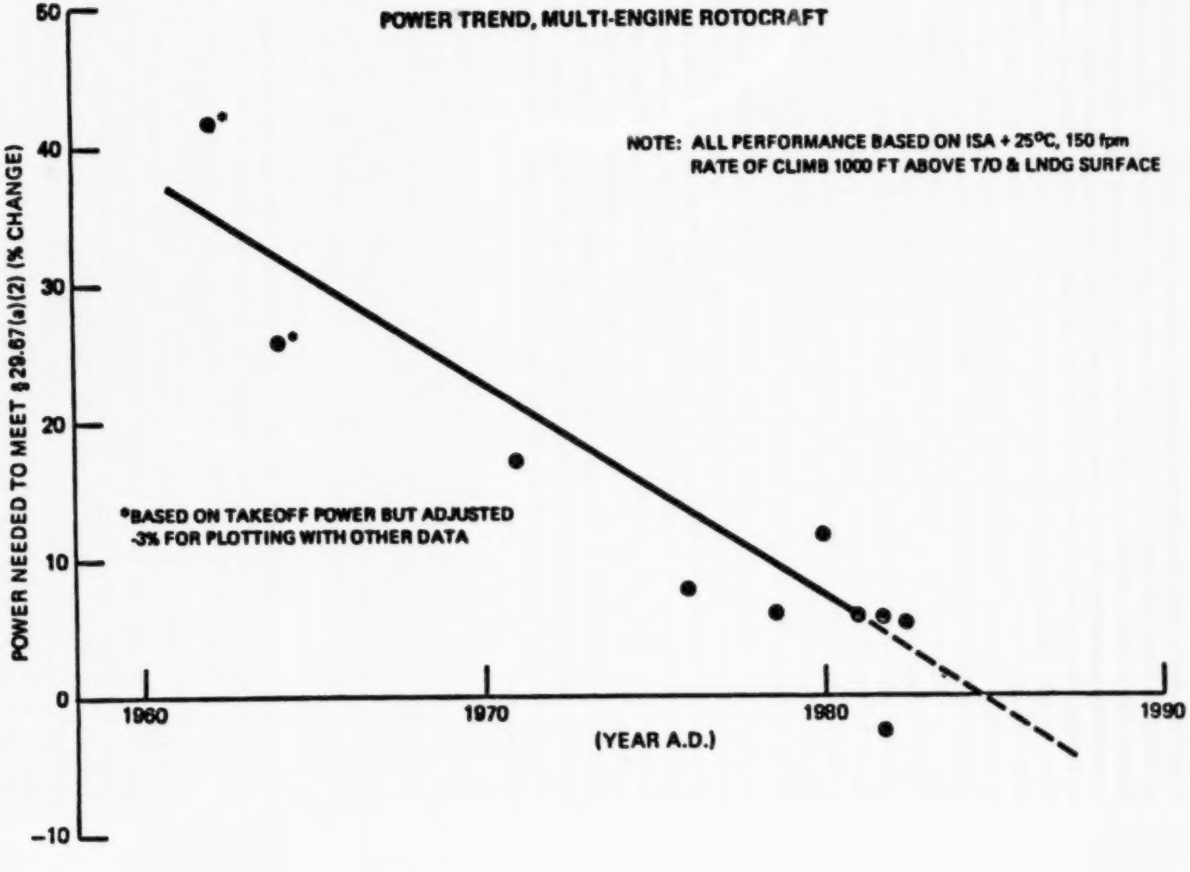
There were no adverse comments submitted to the docket regarding category A design standards for 10 or more passenger rotorcraft. To the contrary, one commenter who opposes the economic aspects of the full category A performance requirement states, "Without exception, new helicopters capable of carrying 10 or more passengers have gone to twin engines for both safety and reliability reasons." It is also true that all new twin-engine designs in that seating range have met category A standards of design. At the NASA-HAA Advanced Rotorcraft Technology Workshop in December 1980, the helicopter users expressed a strong desire to have full category A performance capability in future designs. These desires are summarized in SAE Technical Paper 810589, which states, in part:

> "Concerns relating to powerplants appeared to top the lists of all the users. A true one-engine-inoperative capability was referred to repeatedly and in a variety of ways. The operators were unanimous in their endorsement of twin engine helicopters, but less happy with available single engine performance. Ideally, an out-of-ground-effect hover capability with one-engine-inoperative was desired. In general, operators would like to see a non-emergency outcome for any single failure of any helicopter component."

This rule satisfies a portion of those industry needs and desires. Let us now consider the cost factors involved in adopting the category A climb requirement.

Figure A represents the approximate climb performance capabilities of existing twin-engine models capable of carrying 10 or more passengers. The ordinate, or vertical axis, is the change in power that would be required to comply with the added performance requirement of this rule at the weights originally certificated on existing twin-engine category B models. The abscissa, or horizontal axis, represents the year each model was initially certified for civil use. Where final flight test data were not available for one projected model, manufacturers' estimates were utilized. The necessary power increase is based on an average of two hot day ambient takeoff conditions: (1) Sea level 40°C (ISA+25°C) and (2) 5,000 feet 30°C (ISA+25°C). The data were generated through computations shown in Table I. Necessary horsepower increases were referenced to sea level standard conditions by averaging factors of .8 and .73, respectively. Data for these factors are shown in Table II. These cases include a major portion of the typical helicopter operating envelope but are in no way limiting. A similar trend results when other ambient conditions are used. A curve through the data in Figure A reflects a trend toward lighter components and more powerful engines in transport category rotorcraft. Assuming this trend continues, the added costs of complying with this minimum performance standard will cross the zero cost line in the mid-1980's. This corresponds to the time period during

Figure A



POWER TREND, MULTI-ENGINE ROTOCRAFT

NOTE: ALL PERFORMANCE BASED ON ISA + 25°C, 150 fpm
RATE OF CLIMB 1000 FT ABOVE T/O & LNDG SURFACE

*BASED ON TAKEOFF POWER BUT ADJUSTED
-3% FOR PLOTTING WITH OTHER DATA

Table I

Analysis of Change in Power Required to Meet Category A Enroute Requirement of § 29.67(a)(2)

Two Ambient Conditions Analyzed (and averaged):
Takeoff and Landing WAT [Weight, Altitude, Temperature] Limit at:
(1) Sea Level: ISA + 25°C (40°C/104°F)
(2) 5,000 Feet Pressure Altitude: ISA + 25°C (30°C/86°F)

Helicopter Model	T/O & Landing Weight Limit (lbs)		OEI Climb Rate 1,000' Above Surface (fpm)		*Additional Horsepower (hp) Required to Meet § 29.67(a)(2)		30 Minute Rating (horsepower)	**Percentage Increase in Horsepower Required		Average Percentage Increase Required
	(1)	(2)	(1)	(2)	(1)	(2)		(1)	(2)	
A	19,000	17,750	–460	–620	390	460	1,250	39	50.4	44.7
B	18,330	16,810	–286	–306	269	258	1,250	28	29.5	28.75
C	11,200	10,450	–105	–219	96.2	129.8	900	13.9	20.6	17.25
D	16,300	16,180	150	–200	0	191	1,742	0	15.4	7.7
E	9,800	8,800	25	100	41	14.8	627	8.5	3.4	5.95
F	7,650	6,980	–60	–95	59	57.6	650	11.3	12.1	11.7
G	11,600	10,600	80	5	27.3	51.75	925	3.7	7.66	5.7
H	8,487	7,400	25	50	35.7	24.9	700	6.4	4.9	5.6
I	17,190	17,190	420	40	–156	63.7	2,078	–9.4	4.2	–2.6
J	17,500	16,550	90	–30	35.4	100	1,625	2.7	8.4	5.5 (estimated)

(*) $\Delta \text{ hp required} = \dfrac{\Delta R/C \times \text{Weight}}{29{,}700}$

(**) $\text{percentage increase} = \dfrac{\Delta \text{ hp}}{\text{SL Rated hp} \times \text{\% Available}}$

Table II

Percentage Rated Power Available at Climb Conditions of § 29.67(a)(2)

Engine Model	SL-STD 30 Min Rating	30 Min Rating (1,000'/38°C)	Percentage of S.L. Rating	30 Min Rating (6,000'/28°C)	Percentage of S.L. Rating
1	1,250	950	76	890	71
2	1,380	1,099	80	988	72
3	1,625	1,365	84	1,230	76
4	600	475	79	426	71
5	660	535	81	480	73
Average Percentage of Rated Power Available			80%		73%

which the first new model could conceivably be impacted by this rule. It may, therefore, logically be concluded that the economic impact of the 10 or more passenger requirement incorporated for new models under this rule is approximately zero. The remaining aspects of the applicability rule change are relieving. FAA received no adverse comments on the removal of height-velocity as a limitation for under 10-passenger seat applicants. This will provide additional flexibility to operators, with an unquantifiable potential revenue benefit. FAA, likewise, received no adverse comments on the removal of the 20,000-pound weight limit for category B. This provision could result in increased revenues for operators of new or requalified rotorcraft at the higher weights allowable for category B operations. It is estimated that industry revenue increases of from $5 million to $13 million per year could be achieved in the 1982 through 1989 time frame. Such revenue increases have a net present value of $43 million in 1982 dollars, using a discount rate of 10 percent. Therefore, the overall economic impact upon the helicopter industry of this rulemaking action is to provide moderate to major economic benefit.

Two of the three commenters who oppose the 10 or more passenger rule argue that this rule discriminates against U.S. helicopters and gives foreign manufacturers a distinct advantage. This is not true for helicopters to be certificated and registered in the United States. To obtain an FAA type certificate, foreign designed and manufactured helicopters must meet the same or equivalent standards that must be met by helicopters designed and manufactured in the United States. Section 21.29 makes this point clear. Foreign airworthiness regulating agencies currently recognize Parts 27 and 29 of the Federal Aviation Regulations as the world's leading civil airworthiness standard. Moreover, these standards and their predecessor parts have been used for certification of all civil models which have major impact on the marketplace worldwide. These standards will continue to be recognized and used throughout the free world as long as they reflect appropriate, up-to-date safety standards that clearly prescribe an appropriate safety standard for current technology. If the remaining portion of these certification standards can be updated to reflect an appropriate minimum level of design, they will endure as a world standard, and there will be no gross benefit or competitive advantage to manufacturers, foreign or domestic.

Two commenters state that the proposed applicability revision to Part 27 is not needed because rotorcraft of 6,000 pounds or less are not projected to have more than nine passenger seats. The FAA agrees, and this portion of the proposal has been removed.

One commenter recommends incorporating the category A and category B definitions into the rules for standardization and clarity. The FAA agrees and the definitions are incorporated into Part 1 of the FAR as presented in the explanatory portion of Notice 80–25 without substantive change.

Two commenters contend that the 10 passenger safety comparison between rotorcraft and fixed-wing aircraft in Notice 80–25 is not valid because of the slower landing speeds and the lower rate of fatalities in engine-failure-related accidents for helicopters. This capability is recognized. The FAA, however, cannot condone low-speed crashes simply because they kill fewer people. The FAA is hopeful that increased technology and upgraded performance standards can jointly lead to elimination of engine-failure-caused accidents. Future rulemaking actions in the ongoing rotorcraft review will seek to improve safety in structural, systems, and pilot-related areas through similar upgrading and modernization of the standards with the intent that major accidents, both fatal and non-fatal, can be minimized. The period when helicopters will be routinely flying in IFR conditions with large numbers of passengers is at hand. Uncontrolled descent to the surface is not a viable alternative for these operations. A moderate performance capability for future designs which is consistent with these evolving operations is envisioned in this rule. Nevertheless, this rule recognizes significant differences between fixed-wing aircraft and rotorcraft performance levels, and adopts performance standards for engine failure in rotorcraft which are much lower than those for their fixed-wing counterparts.

A general concern over retroactive application of the proposed applicability rule was noted throughout the comments. The full category A requirement in Notice 80–25 for 10 or more passenger configurations is inappropriate for current multiengine designs under 20,000 pounds because those rotorcraft have been designed to achieve reasonable payload capabilities under category B operating conditions. As seen in Figure A, the implications of adopting only the "en route climb" requirements have steadily diminished in recent years. The FAA has determined that retroactive application would not provide a safety benefit commensurate with the cost. In regard to the specified docket comments, even though an applicant is free to seek and obtain certification to full category A performance capability for competitive advantage with existing models, full category A performance will not be required retroactively for existing models of 20,000 pounds or less.

§ 29.79 Limiting Height-Speed Envelope.

No comments were received on proposed § 29.79. The FAA noted, however, that the words, "covered by paragraph (a) (2) (i) of this section," in the proposed § 29.79(a) (2) (ii) are redundant and, therefore, are deleted. Accordingly, § 29.79 is adopted essentially as proposed.

§§ 27.141 and 29.141 General.

No comments were received concerning reference to control system failures proposed in §§ 27.141 and 29.141 and those sections are adopted as proposed.

§ 29.877 Ice Protection.

Notice 80-25 proposed deleting § 29.877 and establishing updated icing requirements in a new § 29.1419. One commenter suggests retaining § 29.877 along with additional certification guidance material. Section 29.877 inadvertently implies the possibility of limited icing certification. The FAA cannot endorse limited certification because of the inability of the crew to control the limiting conditions, the difficulty in forecasting the severity of icing, and the inability to relate the effects of reported icing among different types of aircraft. This would create the potential for unsafe conditions beyond the capability of the rotorcraft without viable escape alternatives. Although the commenter would like to retain § 29.877 and allow limited icing approvals, the limited icing concerns and objections raised in Notice 80-25 have not been satisfied. Accordingly, § 29.877 is removed and marked "reserved," and § 29.1419 is adopted. Specific comments pertaining to the content of § 29.1419 are addressed elsewhere in this document.

§ 29.1309 Equipment, Systems, and Installations.

One commenter recommends that § 29.1309 be revised to specify requirements relating to probability of failure in a manner similar to that required by § 25.1309 for transport category airplanes. This recommendation is beyond the scope of this rulemaking action, but will be addressed in a subsequent rotorcraft regulatory review notice.

§ 29.1321 Instrument Arrangement and Visibility.

Notice 80-25 proposed grouping and centering specific instruments and, for IFR-certified transport rotorcraft, arrangement and visibility requirements (basic "T" concept) comparable to those for transport category airplanes. One commenter recommends that the grouping and centering requirement be "consistent with the VFR and IFR approach and touchdown visibility needs of the particular helicopter." The commenter contends that exterior visibility requirements are different for rotorcraft than for airplanes, and implies that good exterior visibility and good instrument arrangement may be mutually exclusive. The requirement for grouping and centering of flight instruments has been in this section of the rules for many years and Notice 80-25 did nothing to change this aspect of the requirement. Successful certification of existing rotorcraft which have satisfactorily demonstrated compliance with instrument and visibility requirements has proven that flight instruments may be centered on the panel without compromising VFR capabilities. Instrument arrangement and visibility requirements for IFR flight are the same and are equally necessary for airplanes and rotorcraft. Existing rules require satisfactory exterior visibility for rotorcraft and airplanes. The FAA cannot accept the commenter's rationale and recommendation.

The commenter also recommends a change which provide an exception to the instrument grouping, arrangement, and visibility requirements for centralized displays such as cathode-ray tubes. Specific equipment of this type is more properly addressed on an equivalent safety basis, rather than by attempting in the rule to identify this and other possible variations in equipment that may qualify as exceptions. Approvals by equivalent safety have proven satisfactory in past certifications and the FAA sees no reason why this cannot continue in the future.

Another commenter recommends a change which would have specified an exact size for the movable horizon display in the attitude indicator noted in § 29.1321(b) (1). The readability of a particular instrument depends on many factors in addition to physical size. Specifying a particular size would not, in itself, assure that the intent of the rule is met. It could, in some cases, be overly burdening. Other factors such as sensitivity, clarity of display, and physical distance from the crew may also be relevant. It would be preferable to allow applicants maximum flexibility in meeting the requirement without specifying size parameters which may not contribute significantly to the overall safety objective.

In view of this and the foregoing discussions, § 29.1321 is adopted as proposed.

§ 29.1517 Limiting Height-Speed Envelope and
§ 29.1587 Performance Information.

Under the proposed applicability requirement (§ 29.1) of Notice 80-25, category B rotorcraft could not be certificated with more than nine passenger seats, and height-velocity would be removed as a category B operating limitation, but retained in the flight manual as performance information. No comments were received objecting to the proposed deletion of height-velocity as an operating limitation for the less-than-10-passenger category B rotorcraft. However, because of economic reasons discussed in the applicability portion of this preamble, this rule permits the certification of a "category B rotorcraft" as defined in Part 1, with 10 or more passenger seats. Because of this difference and in keeping with the concept of protection for the maximum number of passengers, it is necessary to retain height-velocity as an operating limitation for category B rotorcraft with 10 or more passenger seats. This is accomplished in § 29.1(a) (2), which requires compliance with § 29.1517 for category B rotorcraft having 10 or more passenger seats. Section 29.1517 is therefore adopted as proposed. Height-velocity would still be removed as an operating limitation and retained as performance information for category B rotorcraft with less than 10 passenger seats.

The proposed wording for § 29.1587 would have required height-velocity data in the performance information section of category B rotorcraft flight manuals. In view of the revised applicability requirements, this is now pertinent only for category B rotorcraft with less than 10 passenger seats. Slightly different wording than that proposed for § 29.1587(b) (6) is therefore needed. Accordingly, the proposed § 29.1587(b) (6) is adopted with the addition of the words "except for rotorcraft incorporating this as an operating limitation."

Appendix B—Parts 27 and 29, Instrument Flight Rules Certification.

The adoption in Parts 27 and 29 of certification standards and operational limitations related to Instrument Flight Rule (IFR) approval of rotorcraft has no economic impact since there will be little change in current operating practices or procedures. Currently, an IFR interim standard, similar to that adopted in this rule, is applied for applicants seeking instrument flight approval. Adopting this rule, therefore, imposes no significant change from current requirements under which 25 instrument approvals and approximately 200 operating helicopters have shown a perfect safety record. IFR certification is not mandatory, so the applicant has the opportunity to evaluate whether the provisions of IFR capability in a given rotorcraft model will be sufficiently attractive in the market to improve revenues, profits, and market-share objectives. Moreover, many rotorcraft have been approved for IFR under earlier interim standards that are so similar to the proposed standards that this proposal does not materially alter any economic considerations. The formal adoption of the interim standards is considered to benefit manufacturers by providing a more stable design standard.

Eleven comments on the proposed IFR appendices were received. The majority of the comments propose editorial changes or word clarifications from that proposed in Notice 80-25. Commenters favor proceeding with adoption of helicopter IFR standards in a final rule, and there are no objections to incorporating certification standards in IFR appendices as proposed in the notice. The disposition of docketed comments is discussed in sequential order as they affect Appendix A (changed to Appendix B in the adopted rule) to Part 27. Changes may apply to both Parts 27 and 29 appendices although this may not be specifically noted in the discussion. Where only one part is affected, it is so noted. Numbering of the major paragraphs (I through IX) in this discussion refers to that in the final rule and as presented in the IFR appendix of Notice 80-25 for Part 27 rotorcraft. The numbering in the Part 29 IFR appendix of the notice is incorrect due to the inadvertent omission of the heading "II. Definitions."

During the formulation period of Notice 80-25, appendices entitled "Appendix A, Instructions for Continued Airworthiness," were adopted in Parts 27 and 29. It is therefore appropriate to retitle the IFR appendix "Appendix B, Airworthiness Criteria for Helicopter Instrument Flight" and to alter the corresponding reference in §§ 27.141(c) and 29.141(c).

Four commenters express concern regarding the disposition of Special Federal Aviation Regulations (SFAR) 29, and approval of rotorcraft currently operating under the SFAR "limited IFR" concept. One commenter expresses concern with the apparent lack of substantive distinction between the level of safety implied for IFR in Part 27 "Normal Category Rotorcraft" and Part 29 "Transport Category Rotorcraft" proposals. Further, this commenter feels that the equipment, systems, and installation requirements of the proposed notice drew excessively upon transport airplane criteria. This commenter proposes additional consideration of proven SFAR 29 standards into the Part 27 IFR criteria.

At the conference in New Orleans, industry representatives expressed a uniform desire to have identical standards for IFR in both normal and transport category rotorcraft. A desire for relaxed standards in Part 27 normal category rotorcraft was not enumerated at the conference, nor at the August 1980 meeting in Washington, D.C. This commenter raises a valid question for consideration. "Should the IFR standards incorporate differences in level of safety between normal and transport category rotorcraft in a similar manner to other portions of these rules, and can the SFAR experience be utilized to help in formulating requirements for the Part 27 rule?"

The FAA initiated SFAR 29 as a study to gather data and operating experience necessary to assess various issues affecting helicopter operations in the IFR environment. A limited number of approvals were granted on the basis of individual aircraft modifications, certain specified crewmembers, crew currency restriction, loading and flight envelope restrictions, and geographic limitations which were later removed. These approvals were not generally applicable to the civil helicopter pilot population or to the VFR helicopter fleet as a whole. Although the program began slowly, a moderate amount of IFR flight experience has been gained, particularly during the last two years of his study. During the intervening time period, the interim standard for IFR certification has undergone the final adjustment necessary to incorporate these standards into the rotorcraft certification rules. The explanatory information announcing the renewal of the SFAR on October 30, 1980, stated "it is the intent of the FAA to rescind this SFAR upon adoption of the new rotorcraft IFR certification standards in Parts 27 and 29. . . ." SFAR 29 has served its purpose, and FAA has no need to continue the study.

SFAR 29 has served well as an interim measure to permit joint airworthiness and operational certification of rotorcraft not originally type certificated for IFR operations to engage in IFR operations and, as originally intended, has lead to the adoption of permanent airworthiness certification standards incorporating the airworthiness features developed and the operational lessons learned under the SFAR. Nonetheless, although the SFAR's limited goal of permitting study of rotorcraft IFR operations has reached fruition in the shape of these amendments, a need remains to permit continued operations under SFAR 29 by operators who obtained approvals to operate thereunder prior to the effectiveness of these amendments. Significant amounts of money have already been expended to obtain SFAR 29 approvals, and while eligibility for new applications under the SFAR will expire, FAA considers that blanket termination of these operations would represent a significant economic burden to a number of small entities. For this reason, while future applicants for rotorcraft IFR certification must meet the airworthiness standards contained in these amendments, SFAR 29, as amended, will remain effective for operators holding approvals obtained prior to effectiveness of this amendment. SFAR 29, as amended, will be rescinded when the outstanding approvals granted thereunder have been surrendered, revoked, or otherwise terminated.

IFR flight hours for SFAR 29 operators have been gained since initial drafting of the Part 27 IFR appendix in March 1980, and the FAA has viewed these operations with continuing interest. Certain relaxatory changes in the IFR appendix for Part 27 rotorcraft are adopted in this amendment, partly as a result of the SFAR 29 experience. These changes are primarily in the area of required instruments and equipment. They are discussed below, along with other changes in response to industry comments.

I. *General.* No unfavorable comments were received on this paragraph.

II. *Definitions.* The term V_{MINI} is defined in both appendices as "instrument flight minimum speed. . . ." Some commenters feel this definition applies only to level flight, and further that an IFR approach could be legally flown at a speed below V_{MINI}. These commenters feel an additional term is needed to define minimum authorized approach speed.

The term V_{MINI} constitutes the minimum speed authorized for all instrument flight conditions and is not limited to the level flight condition. The level flight condition is not referred to anywhere in the definition of V_{MINI}. V_{MINI} is the lowest authorized airspeed for IFR climb, cruise, descent, and approach conditions, and it represents the minimum speed at which the helicopter complies with all IFR handling quality requirements, including those during approach. V_{MINI} is by definition ". . . instrument flight minimum speed. . . ." It is, therefore, unnecessary to define an additional minimum speed which is applicable only to approach conditions.

III. *Trim.* Commenters are highly supportive of the IFR trim requirement as worded in the notice. One commenter, however, feels that the wording requires a pilot adjustable control for directional trim. The wording of this requirement does not speak to a pilot adjustable trim control and such a requirement was not envisioned. Several configurations have been approved with no directional trim system as such, but through the use of balance weights and control system friction. Wording of this requirement would permit continued approval of those systems. Additional clarifying information will be provided through FAA handbook guidance.

IV. *Static Longitudinal Stability.* This section of the proposed Part 27 IFR standard contains differing requirements for single- and dual-pilot approvals. One commenter objects to varying standards by the number of crewmembers, primarily because pilot incapacitation in a two-pilot aircraft could result in an unacceptable workload for the remaining pilot. Two commenters object to varying standards by the number of crewmembers only in Appendix B to Part 27. They feel that two-pilot alleviation should be extended to Part 29. SFAR 29 experience has shown that safe operation can result from relaxed levels of stability and design for certain two-crewmember operations. Nevertheless, as stated in Notice 80-25, "It is inappropriate to permit less stringent handling qualities for transport category than for normal category, regardless of crew requirements." In answering these commenters' objections, it is necessary to point out that crew incapacitation is not a consideration in developing IFR flight criteria, and that it is important to retain the highest level of safety through the highest minimum standard for design in transport rules, regardless of the minimum number of crewmembers necessary to operate the aircraft. Therefore, the proposal which relaxes two-pilot requirements only in Part 27 is retained.

One commenter indicates a desire to use control position stability as a basis for static stability instead of control force stability for the two-pilot case. Another commenter proposes use of position stability unilaterally. Numerous studies have been conducted on the subject of static longitudinal control force stability. In addition to NASA and military studies on the subject, the FAA, in recent research and development programs with both the NASA Ames Simulator Facility and the Canadian National Research Council variable stability research helicopter, has conclusively substantiated the need for static longitudinal control force stability in helicopter instrument flight. These most recent results are documented in NASA/FAA Report FAA-RD-80-64 and in "An Evaluation of IFR Handling Qualities of Helicopters Using the NAE Airborne Simulator," April 1, 1981, presented at CASI Flight Test Symposium, Cold Lake, Alberta, Canada. It is, therefore, appropriate to retain this minimum level of safety for single-pilot operation throughout the IFR flight envelope. For a crew of two pilots, the positive static longitudinal control force stability requirement is retained only for conditions of cruise and approach. This will assure a minimum level of stability during a majority of a typical IFR mission and during the critical approach phase.

Another commenter points out that the 10 percent return-to-trim requirement could apply to two-pilot approvals as well as single-pilot approvals. It was not FAA's intent to require a 10 percent return-to-trim condition for a crew of two pilots in Part 27 helicopters and a satisfactory level of safety can be shown, based partly on the SFAR 29 experience. This feature is being clarified by incorporating the words "For single-pilot approvals," as a lead-in to the last sentence of paragraph IV(a) of Appendix B for Part 27 helicopters.

One commenter points out that if V_H were lower than V_{NEI}, demonstrations of static longitudinal stability in cruise would not include the speed range from 1.1 V_H to 1.1 V_{NEI}. FAA is aware of that fact. FAA and industry representatives, in drafting these requirements, continued a long-standing concept presently in VFR certification rules which removes from consideration speeds substantially exceeding V_H. For helicopters with V_H below V_{NE}, this concept assures stability in a reasonable range either side of the maximum attainable level flight speed. This level of stability has proven to be suitable as a minimum airworthiness standard for helicopter IFR flight in more than 20 engineering approvals for IFR flight over the past 8 years. The FAA can see no need to increase the severity of this requirement and it is adopted as proposed.

Three commenters note that lower helicopter IFR approach speeds are forthcoming, particularly for approaches to heliports or offshore facilities. Under guidelines of previous interim standards, an approach speed of 40 knots would require demonstration of stability down to 20 knots or to ½ of the approved airspeed value. A 20-knot approach speed presumably would require stability to a hover. The requirement, as currently worded, would be inappropriate for very low speed approaches and would be difficult to interpret for recommended speeds below 20 knots. Commenters suggest a factored or ratioed method to accommodate the anticipated lower approach speeds. Two commenters suggest 0.9 V_{APP} as a minimum demonstration speed, where V_{APP} is defined as the instrument flight minimum speed utilized in instrument flight approaches. The third commenter proposes 0.8 V_{APP}. A minimum recommended IFR approach speed for helicopters is typically 60 knots. FAA is not aware of any designs certified with minimum speeds greater than 70 knots. To retain approximately the same stability level as that provided in past versions of the IFR standard, a factor of 0.7 times the minimum recommended approach speed is appropriate. For a 60-knot minimum approach speed, this factored method will require static stability throughout a speed range 18 knots below the minimum approach speed compared to the current requirement of 20 knots. At the same time, this method will decrease the required stability range for lower approach speed conditions. For example, a 30-knot minimum approach speed would result in a positive stability demonstration down to 9 knots below that value. Since this rule contains essentially the same requirements as for current designs and provides significant and appropriate relaxation for low-speed approach conditions anticipated in the near future, it is being adopted without a further comment period.

V. *Static Lateral-Directional Stability.* One commenter objects to deleting the term "substantially proportional" from previous interim standards and substituting "proportional" in the directional stability requirement of Notice 80-25. This change was proposed for the purpose of removing subjective wording from the requirement when drafting the notice. This commenter interpreted the word "proportional" to mean in constant proportion. This was not intended by the FAA in its drafting of the notice. To prevent future difficulties in interpretation, the word "proportional" is being replaced by the phrase "in approximately constant proportion" to allow some curvature in the sideslip response to pedal position while retaining the "approximately constant proportion" necessary for good directional response.

Three commenters suggest that the wording "that at which full directional control is employed" is redundant because this condition also represented a "maximum sideslip angle appropriate to the type." Even though this wording has been carried forward in several versions of the IFR interim standard, FAA agrees that these words are redundant, adding nothing to the content of the rule. Accordingly, these words are deleted from the text as adopted.

One commenter states that the wording of the lateral-directional paragraphs is too subjective because the lack of quantitative parameters frequently causes large economic impact in the design of aircraft systems. The lateral-directional requirements of the IFR interim standards have changed little over the past 10 years. These requirements have been utilized successfully on approximately 25 IFR certification programs. Various research and development efforts, both inside and outside of FAA, have been conducted during this period, but none have successfully tied quantitative values for control force and deflection versus sideslip angle to specific levels which will assure a minimum safety standard for a wide range of helicopter models. It is conceivable that minimum safe values for control motion and force versus sideslip angle vary from model to model because of the wide variations in lateral-directional characteristics among rotorcraft. Therefore, the widest possible latitude has been allowed in establishing the minimum acceptable dihedral (roll due to sideslip) characteristic. To specify purely quantitative standards in this area would exclude a certain number of otherwise acceptable designs from IFR approval. For these reasons, quantitative force and deflection criteria for lateral-directional stability are not adopted in this rule.

Another commenter proposes adding dihedral requirements for sideslip angles which exceed 10°, but this is rejected for the same reasons. This same commenter points out an inconsistency in the use of the word "must" in Part 27 versus "shall" in Part 29 in the last line of paragraph V(b). No difference was intended and "must" is adopted for both.

VI. *Dynamic Stability.* One commenter feels that all dynamic stability criteria for Part 27 helicopters should be stated in qualitative terms because many existing helicopters cannot meet the proposed requirement and operator experience under SFAR 29 does not corroborate the need for a quantitative standard. Another commenter charges that the FAA had ". . . deviated from the objective-type rule concept in one very important area—the periodic response characteristics." The FAA assumes that this comment is meant to apply to the "aperiodic" requirement in proposed VI(a) (4) and (b) (3), because the requirements for damping of "periodic" motion in paragraph VI do not deviate from previous versions of the IFR interim standard. This assumption is supported by a commenter statement in another area of the submittal: ". . . the FAA did not establish a basis in its 'explanation' for the value selected for the quantitative aperiodic response nor was the value selected shown to be compatible with the comparable characteristics of helicopters now approved. . . ."

Dynamic response characteristics represent an avenue of vehicle description which by their very nature are specific, quantifiable, and understandable in universal terms.

Regardless of the type of vehicle, dynamic response must be controlled to assure satisfactory operation. It has long been recognized that quantitative standards for helicopter instrument flight are needed to assure fair and consistent administration of the requirement. The fact that some current designs approved for flight under visual flight rules (VFR) do not meet a proposed standard for instrument flight rules (IFR) is not justification for concluding that the standard is inadequate. Rotorcraft must be designed to minimum safety standards and those standards should reflect only those requirements necessary for safe flight. The standard, however, must not be formulated simply to comply with characteristics of current rotorcraft.

A large majority of SFAR 29 operators are approved for a minimum crew of two pilots and a majority of those helicopters are capable of meeting the periodic (oscillatory) damping requirements in paragraph VI(b). The few others were approved largely on the basis of pilot capability and these configurations should not be considered suitable for a national airworthiness standard appropriate for the civil pilot population as a whole. The periodic standards proposed in Notice 80-25 have been applied in over 20 civil certification programs and have been well established as a true "minimum" rather than a "highly desirable" design standard. It is interesting to note that some of these models have met the dynamic stability standards without stability augmentation. Because of this considerable experience and high level of confidence, the periodic portion of this requirement is adopted as proposed.

In helicopters, aperiodic modes are frequently manifest and are of equal importance in defining safe vehicle response. The FAA stated in its explanation to Notice 80-25 that, "pilot perception of aperiodic responses is similar to that for oscillatory responses which exceed a 20-second period and typically result in gradual rates of divergence over the first few seconds of aircraft motion. Although lower in attitude rate and acceleration level than the oscillatory modes, aperiodic requirements have been held to the same level of divergence as oscillations with a 20-second period due to their more insidious nature." This discussion applies well for axes in which both oscillatory and pure divergent modes exist. In pure roll dynamics, however, no oscillatory dynamic mode exists. Instead, an aperiodic spiral mode with low roll damping is typical and must be considered because it falls within the definition of an aperiodic response. As was recommended by the second commenter, FAA researched previously approved IFR models and determined that the most unstable aperiodic spiral divergence currently approved in a normal category rotorcraft had a time to double amplitude of 6 seconds. This level of instability was described as marginal in the FAA flight test report and appears appropriate for consideration as a minimum standard. No transport category helicopters have been certified without stability augmentation. The worst condition shown during testing with single stability augmentation system (SAS) failure, however, has shown an approximate 9-second time to double amplitude. These results indicate a need to limit the larger transport rotorcraft to a level of aperiodic response which is proportionally lower in divergence than is permitted for the lighter, more maneuverable normal category case. For this reason, the 9-second standard is adopted for transport category. For small rotorcraft with a minimum crew of two pilots, no minimum aperiodic criterion is adopted because it is assumed that one pilot will be at the controls and actively flying at all times. The military specification for flying qualities of piloted V/STOL aircraft, Mil-F-83300, defines a level 2 handling quality as one which is ". . . adequate to accomplish the mission Flight Phase, but some increase in pilot workload or degradation in mission effectiveness, or both, exists." For this condition, an allowable time to double amplitude for aperiodic response is 12 seconds. The adopted FAA standard is less stringent than the level 2 requirement. Mil-F-83300 defines a level 3 handling quality, in part as one ". . . such that the aircraft can be controlled safely, but pilot workload is excessive or mission effectiveness is inadequate, or both." Allowable times to double amplitude for pitch and roll in level 3 are 5 and 4 seconds, respectively. The military standard tends to endorse the 6- and 9-second times to double amplitude previously approved by FAA for civil application. A current FAA research and development program is addressing aperiodic divergence. Initial results support the fixed levels of aperiodic divergence adopted here. This rule, therefore, is relaxed from that proposed in Notice 80-25 to a level of aperiodic instability which allows doubling in amplitude every 6 seconds for single-pilot, normal category rotorcraft and every 9 seconds for transport category rotorcraft. The adopted stability levels are based on existing models which have established an acceptable operating experience in service, previous handling qualities standards for fixed- and rotary-winged aircraft, docketed comments on this rulemaking action, and current FAA research efforts. Suitable methods for testing aperiodic levels of divergence will be included in a forthcoming procedures manual.

VII. *Stability Augmentation System (SAS).* Several commenters recommend that the pilot delay times for SAS failure should be provided. One recommends that maximum allowable helicopter attitudes and rates following SAS failure should also be specified. Stability systems are rapidly becoming more sophisticated and complex. The ability to specify a single minimum standard for attitudes, rates, and pilot delays which would be suitable for all stability systems in all IFR rotorcraft models is doubtful. Disposition of this information as policy material has worked well in previous fixed-wing experience. In its explanation to Notice 80-25, FAA stated that "Pilot delay times for stability system malfunction testing are excluded from this amendment, as these criteria are more appropriately addressed in flight test guidance material." Guidance on these specific areas has been drafted for a transport helicopter certification guide which will be issued shortly. Draft copies are available from the FAA Helicopter Directorate, ASW-110, Box 1689, Ft. Worth, Texas 76101. No negative comments were received on incorporating this information as guidance material and this feature will remain unchanged in the adopted rule.

One commenter states that a SAS approval based primarily on statistical analysis would not be acceptable to FAA and VII(a) should reflect that philosophy. The basic premise behind the comment is valid. Paragraph VII states, in part that, "the occurrence of any failure condition which would prevent continued safe flight and landing must be extremely improbable." While compliance with a portion of this requirement may be satisfied by conducting SAS hardover tests, many other failure conditions are not flight tested because they are shown to be extremely improbable through a combination of failure analyses, environmental tests, mock-up tests, or component service experience. In this regard, the appropriate hardover conditions are addressed in paragraph VII(b), which specifically includes the eligibility of statistical methods.

Two commenters point out that a wording change from the interim standard had occurred in paragraph VII(a) (1) regarding the appropriate failure conditions to be considered. The IFR interim standard limited this requirement to failures "of the primary control system." The intent of this requirement is to assure that probable SAS failures in combination with probable conditions elsewhere in the control system do not combine to prohibit safe flight. This lack of specific reference to the control system in Notice 80-25 is noted and an appropriate revision is made. The requirement is further simplified and clarified by eliminating a redundant reference to "Combinations of Failures" which can be considered within the existing terminology of "Probable Failures."

One commenter states that the flight criteria following SAS failure in paragraph VII(a) (2) should not require continued compliance with all of the flight characteristics requirements of Parts 27 and 29 because, for like conditions in § 25.672(c), fixed-wing transport aircraft are required to comply only with controllability and maneuverability requirements of Part 25. This commenter states that, "Unless the FAA identifies inherent differences between helicopters and transport category airplanes relevant to continued flight following SAS failure and defines how those differences warrant the more stringent flight characteristics being proposed in the NPRM, the same criteria should apply."

Several SFAR 29 IFR interim standards, including the most recent dated December 15, 1978, required continued compliance with not only the flight characteristics portion but the entire Subpart B of Parts 27 and 29. This Subpart B requirement was relaxed to specify only the "Flight Characteristics" portion of Subpart B in Notice 80-25. There are significant differences in handling qualities requirements between helicopters and transport category airplanes and those differences are apparent in the basic rules for these two aircraft types. The differences, however, are more basic than the differences between helicopters and airplanes. The basic Part 25 transport airplane requirements for controllability and maneuverability are IFR requirements which provide suitable characteristics for IFR flight following a SAS failure. The flight characteristics requirements of Part 29 for rotorcraft are VFR requirements intended to provide suitable characteristics for VFR flight. For this reason, sections of Part 29 are not necessarily comparable to sections of Part 25 on a one-to-one basis as urged by the commenter and the requirements referenced in Part 29 are certainly not more stringent than those of Part 25. The less-stringent VFR handling qualities are permitted on the basis of a lower level of stability inherent to helicopters under SAS failure conditions. To further lower the standard would compromise a SAS failure criterion which has been used successfully in approximately 25 IFR approvals.

The commenter states that the full flight characteristics standard had not been met on one particular FAA approval and that the requirement should therefore be further relaxed. This FAA standard should not be structured based on exceptions. Rather, it should provide an appropriate minimum. To lower this standard because of a single case for which the standard did not apply is unwarranted and the wording of this section is adopted as proposed in the notice.

One organization recommends that credit toward meeting the single-pilot IFR stability requirements be given for installing an autopilot. The term "autopilot" has been subject to many definitions and interpretations in the helicopter community. It has been defined as anything from a SAS which would be eligible under Paragraph VII, to a conventional autopilot which manipulates the primary flight controls and has no pilot "fly through" capability. The definitions also vary in reliability and complexity from a single-axis, wind-driven, wings-leveler device to a highly reliable, multipath, integrated system which would perform virtually all normal instrument flight maneuvers under probable failure conditions. To allow blanket credit for such a variation in capabilities cannot be permitted. If the system stabilizes the rotorcraft by allowing the pilot to "fly through" and perceive a stable, well-behaved vehicle, it qualifies as a SAS, clearly receives credit under paragraphs III through VII, and may be utilized for compliance with all handling qualities requirements. If a conventional autopilot does not provide "fly through" capability or allow the pilot to perceive a stable, well-behaved vehicle through his manipulation of the flight controls and the related feedback from those controls, then it tends to remove him from active involvement in flying and is eligible primarily as a workload reliever. Credit has been granted on that basis during previous certification programs. Since the commenter does not include any justification to show why these provisions for "autopilot credit" should be changed, they will continue to be applied as before, and this portion of the rule is being adopted as proposed.

VIII. *Equipment, Systems, and Installation.* One commenter states that small helicopters should not have to comply with the Category A power supply requirement of § 29.1309(d) as indicated in the lead sentence of paragraph VIII. A category A electrical system requirement was never intended for small helicopters. Upon closer inspection of this paragraph, it is determined that the reference to § 29.1309 was not needed to define basic equipment and installation requirements and is removed. In its place a reference to § 29.1433 is added to the requirement for small helicopters to provide criteria for vacuum systems equivalent to that for electrical systems in § 29.1431. This change also helps clarify a later reference to "power supply" in paragraph VIII(b) (3) which was unclear to two commenters. The addition of a reference to § 29.1433 clearly indicates the eligibility of power sources other than electric for those flight instruments requiring a power supply. The addition of examples of sources used to power required flight instruments in paragraph VIII(b) (3) further aids in clarifying that requirement.

Two commenters feel that the required flight instruments should be clearly defined and listed as is done in § 25.1303. Upon review, it was found that § 25.1303 lists the same flight instruments as § 29.1303 plus a mach meter and speed warning which are currently only in Part 25. A further listing of the required flight instruments in the IFR appendix would be redundant with § 29.1303 and is, therefore, not incorporated.

One commenter feels that a vertical speed indicator should be required for IFR flight and four commenters want to delete the requirement for an instantaneous vertical speed indicator (IVSI), particularly for small rotorcraft. A fifth commenter recommends developing a performance standard for IVSI's.

A vertical speed indicator is specifically required in § 29.1303. As to the remaining comments concerning a vertical speed indicator, it is apparent that considerable confusion exists in the term "IVSI," and that neither industry nor government has defined the term sufficiently to clearly determine its meaning or its appropriate level of performance. Even though the IVSI requirement has been carried forward in renewed versions of the helicopter interim IFR standard, it is inappropriate for a final rule, lacking a defined standard of performance. For this reason, the proposed requirement for an IVSI in place of the standard vertical speed indicator is not adopted.

Two commenters suggest that the statement in VIII(a) (2) which prohibits the use of standby batteries for engine starting should be removed from the Part 27 requirement. These comments are based primarily on the high cost of existing self-contained standby attitude indicators and on satisfactory operating experience in some SFAR 29 configurations which use standby batteries to assist in engine starting. One of these commenters argues that this is a particular burden for small helicopters because of the high initial capital expenditure and the high percentage loss of payload. FAA has considered these comments in light of the SFAR 29 experience and the difference in intended level of safety for normal and transport categories. FAA agrees with the less stringent requirement suggested by these commenters for normal category. The requirement to exclude the standby batteries from engine starting is therefore removed from the normal category requirement.

One commenter indicates that the requirement for a magnetic gyro-stabilized direction indicator is excessively stringent for normal category rotorcraft. The commenter's opinion is based on SFAR 29 experience with a gyro-stabilized direction indicator set by reference to a magnetic direction indicator (often referred to as a whisky compass). FAA's experience in certifying direction indicators for IFR flight in helicopters reveals that a magnetic direction indicator, used in conjunction with a non-magnetic gyroscopic indicator, is suitable for flight in smooth air. For operation in moderate turbulence, however, the magnetic indicator is unsuitable. The effect is more degrading and much more severe in helicopters than for their fixed-wing counterparts. In Notice 80-25, FAA stated that ". . . the nonstabilized magnetic indicator, which is subject to many errors, is inadequate as the primary source of directional information, but it must remain as an emergency source. The standard directional gyro is also inadequate as the primary source of directional information because of drift and the requirement to set it by reference to some other precise reference. Therefore, a gyro stabilized magnetic direction indicator would be required." Comments submitted have not addressed the degraded level of navigation performance associated with helicopters operated in turbulence without a magnetic gyro-stabilized indicator. Therefore, the requirement for a magnetic gyro-stabilized direction indicator proposed in Notice 80-25 is considered necessary to assure safe navigation capability and is adopted in the final rule.

One commenter states that the isolation features contained in paragraph VIII(b) (5) (that is, paragraph VIII(b) (6) of Notice 80-25) should not be required for normal category rotorcraft because these were basically transport airplane standards. The commenter feels essentially that independent sources are not necessary. These requirements are intended to assure that, for dual-pilot configurations, the first pilot station has a dedicated source for required flight instruments and that the required flightcrew operations are not compromised by the installation of additional equipment. Handling qualities criteria for normal category two-pilot operation are significantly relaxed from those required for single-pilot approval. Part of this relaxation includes a very limited longitudinal stability requirement and the lack of a return to trim requirement. This low initial level of stability makes it mandatory that accurate airspeed, altitude, and attitude information remain available to the required crew complement during both normal and reasonably anticipated failure conditions. This requirement is much more vital to a helicopter, which barely meets two-pilot helicopter instrument flight criteria, than it would be for small or transport airplane applications or for single-pilot IFR helicopters because all of those configurations have both a static longitudinal stability requirement throughout the flight envelope and a 10 percent return-to-trim requirement. These two requirements greatly aid aircraft control when airspeed indications are lost. Also, power changes in helicopters typically result in significantly greater longitudinal control changes than in fixed-wing airplanes. In the absence of at least one reliable airspeed and altitude indication, airspeed control in IFR helicopters can be quickly lost when performing even moderate power changes. For these reasons, it is necessary to adopt the proposed level of design for configurations requiring two pilots.

For configurations meeting the normal category single-pilot requirement, instruments for a second crew station (for training or at customer request) would not be "required instruments" and could be powered from existing sources which are used for other equipment.

One organization comments that by requiring calibration of the alternate static source in paragraph VIII(b) (5) (iv) (that is, paragraph VIII(b) (5) (ii) of Notice 80-25), this requirement would result in alternate source calibration cards in the cockpit. A calibration card, however, would only be required if the alternative source could not meet the 50-foot accuracy requirement of §§ 27.1325 and 29.1325.

One commenter states that §§ 27.1365 and 29.1365 allow circuit breakers or fuses to be used as protective devices, but in practice FAA has not permitted fuses on flight-critical items due to IFR pilot workload constraints. This commenter recommends a regulation to require circuit breaker protection for all required IFR systems. FAA has found both circuit breakers and fuses acceptable as protective devices for essential systems provided they can be located and identified to allow ready reset or replacement in flight. This requirement is found in §§ 27.1357 and 29.1357. FAA does not prohibit the use of fuses provided they are accessible and replaceable in flight and that sufficient spare fuses are available to the crew. We can find no justification for changing the requirements at this time.

One commenter suggests that autopilots and flight directors are included under the requirements of paragraph VIII(b) (5) (i) and that specific cockpit lighting requirements, switch positions, and annunciation be required for helicopter IFR. Neither flight directors nor autopilots are required for IFR certification in helicopters. They, therefore, do not come under the definition of "required flight instruments" (those listed in § 29.1303) and are inappropriate for inclusion in this requirement. Cockpit lighting, switch position, and annunciator requirements are contained in general regulatory requirements and in more specific handbook criteria and policy guidance. Requirements in these areas are generally worded to allow innovation and variation in design. For a design requirement which has as its primary purpose establishing a minimum level of safety, incorporating specific requirements for these areas would not enhance safety or otherwise serve the needs of industry. The freedom to allow innovation in design should be retained and for this reason more specific requirements are not imposed.

Several commenters suggest clarifying the wording of paragraph VIII. Most of the wording was initially derived from similar requirements for other types of aircraft in other Federal Aviation Regulation parts. These comments have been reviewed and several changes are made to simplify and clarify wording, with no change in intent from Notice 80-25: (1) Examples of typical power supplies are included in paragraph VIII(b) (3) to indicate that the power supply indicator is not intended solely for electrical instruments; (2) Words are added in paragraph VIII(b) (4) to indicate that this requirement is only for multiple systems which perform like functions; (3) The words "the pilots" in paragraph VIII(b) (6) (ii) (of Notice 80-25) were changed to "a pilot" (in paragraph VIII(b) (5) (iii) of the rule) to more clearly indicate that information essential to safety of flight must remain available to at least one pilot following single or probable failures; (4) Wording is added to paragraph VIII(a) (2) in the rule (proposed paragraph VIII(a) (3)) to indicate one pilot's primary attitude indicator could satisfy the standby attitude indicator requirement for two-pilot configurations; (5) Paragraphs VIII(b) (5) and (6) of Notice 80-25 are reorganized, reworded, and simplified. The paragraph designator (6) is eliminated in the final rule. Concepts have been clarified, consolidated, and described by simpler wording throughout these paragraphs, and no change in meaning from Notice 80-25 is intended.

IX. *Rotorcraft Flight Manual.* One commenter proposes a requirement that new performance data must be presented either in the manufacturer's format or in a format created by the "STC facilities." It is unclear how such a requirement would improve safety. Any flight manual performance presentation which is clear and functional is acceptable to FAA regardless of format. The proposed change offered no rationale to show why other methods of presentation should not be allowed. Therefore, the proposal is not incorporated in this flight manual requirement.

§§ 27.1419 and 29.1419 Ice Protection

The rule adopted in §§ 27.1419, 29.1419, and Appendix C to Part 29 establishes minimum safety standards for certification of rotorcraft for flight in icing conditions. Compliance with this rule is not required of all rotorcraft; it would be required only for those rotorcraft for which icing certification is requested. This rule simply requires that rotorcraft be capable of operating safely in icing conditions and defines the natural icing environment for certification. The defined icing environment is the same as that utilized and accepted for many years in icing certification of fixed-wing aircraft, except that inherent altitude limitations of helicopters are recognized.

Even though no U.S.-manufactured helicopters have been certified for flight in icing conditions, the need for icing certification criteria for helicopters has been recognized by industry and FAA. The helicopter industry, some time ago, requested that criteria be developed, and the FAA embarked on a program to accomplish this goal. FAA has developed icing special conditions for current rotorcraft programs and these requirements are substantively identical to those incorporated by this rule. Even if formal icing rules were not adopted, icing requirements similar to these would be applied as special conditions in those cases where icing certification is requested. There is, therefore, no economic impact in adopting this icing rule. Certification of rotorcraft in icing is a logical next step to the rapidly increasing usage and projections for increased future operation of rotorcraft in IFR conditions. A foreign-manufactured helicopter was recently approved by that foreign country for flight in icing conditions and developmental flight tests by several U.S. helicopter manufacturers have begun with the intent to obtain icing certification on new and existing models.

This icing rule is in accordance with the economic and regulatory guidelines of Executive Order 12291. As noted in Notice 80-25, the adoption of icing certification standards has no economic impact. Since certification for icing is not required of any rotorcraft, this rule merely offers an additional option for expanding rotorcraft utilization. The manufacturer and operator are not obligated to comply with these icing requirements and they have the option of deciding whether or not adoption of the capability to operate in icing offers an overall economic benefit for their particular application.

If flight in icing conditions is to be attempted, certified ice protection provisions offer positive safety benefits to people traveling in rotorcraft. Flight in icing conditions in any aircraft can entail risk due to increased structural loads and drag, and loss of lift, engine power, aircraft performance, stability, controllability, and forward visibility. Operating rotorcraft in icing can introduce additional risks due to the potential loss of autorotational capability with an iced main rotor and high vibrational stresses with an unbalanced rotor when asymmetrical ice shedding occurs. Certification with adequate ice protection provisions can eliminate these risks and, thereby, enhance safety for people traveling in rotorcraft in icing conditions.

In view of the need, economic viability, and positive safety benefits of rotorcraft icing certification, the FAA participated jointly with the U.S. Army in icing research flight tests involving various helicopters. In consideration of this experience and other pertinent icing data, a rotorcraft icing certification standard was proposed in Notice 80-25. Comments have been received, carefully considered, and are discussed as follows.

Most of the comments submitted on the proposed icing rules, along with the FAA responses, apply to both the proposed §§ 27.1419 and 29.1419, although this may not be specifically noted in the comments. Where a comment applies to only one specific section, it is so noted.

It was correctly noted by one commenter that an Appendix A has been added to Parts 27 and 29 in the last year. Appendix A, Airworthiness Criteria for Helicopter Instrument Flight, and Appendix B, Icing Certification, as proposed in Notice 80-25, therefore become Appendix B and Appendix C, respectively, in the final rule.

Several commenters suggest changes that would allow limited or partial icing certification, that is, approval of an icing flight envelope which limits the range of natural icing parameters (liquid water content, droplet size, and outside air temperature) in which the rotorcraft can operate, or approvals with an ice protection system which provide only partial capability to operate in natural icing conditions. It is recognized that a specific rotorcraft may not have the capability to operate at the higher altitudes specified in Appendix C. Altitude, unlike other icing parameters (liquid water content, droplet size, and temperature), can be controlled by the flightcrew and therefore may be considered as a limiting condition in icing certification provided an operationally practical altitude envelope is available. It is not the intent of the FAA to require certification to icing parameters which cannot be encountered within the altitude capability of the rotorcraft. However, the concerns and objections to limited icing certification were stated in Notice 80-25. These are based on minimum safety considerations. Although several commenters recommend permitting limited certification, neither the FAA nor the commenters could provide a means of satisfying these concerns and objections. Therefore, the commenters' suggestion to permit limited or partial icing conditions per se is not adopted at this time. However, limiting a helicopter's altitude will result in changes to associated parameters such as liquid water content and temperature. A pilot would not directly control liquid water content or temperature, but at lower altitudes, the most severe combinations would not be encountered. A suitable icing envelope relating the changes in these parameters will be included in a forthcoming procedures manual.

One commenter recommends that Appendix C, which defines the icing environment for certification, be adopted as an "interim rule" for a fixed period of time, pending verification of the raw data and statistical procedures used to construct the curves. The criteria of Appendix C were developed by NACA (now NASA) and have been used successfully by FAA for over 25 years for certification of fixed-wing aircraft in icing conditions. Special consideration for the limited altitude capability of most rotorcraft is incorporated in the rotorcraft icing rule. However, in response to requests from industry, the FAA is sponsoring a reassessment of the criteria in Appendix C. Initial results of that review do not substantiate a change. In view of this and the long history of successful application, it is inappropriate to apply Appendix C on an interim basis at this time. Should the final results of the reassessment indicate a change is appropriate, such a change would be considered at that time. This effectively accomplishes the intent of the commenter's recommendation without being committed to the effort and expense of further rulemaking at a specified future point when final results may not be available and a change may or may not be warranted. Accordingly, Appendix C is being incorporated in the rule as proposed.

Two commenters recommend that the proposed rule be revised to permit extrapolation, due to the great expense and low probability of encountering extreme conditions during natural icing tests. Considerable analysis to show compliance with extreme conditions has been successfully used in icing certification of fixed-wing aircraft. It may be considered by the certification authority for rotorcraft icing approvals, depending on the similarity of results obtained by flight tests in natural ice with results obtained by analysis. In general, the rules contain minimum safety criteria. Specific means of compliance are not usually specified, in order to allow applicants maximum flexibility in methods of showing compliance. The subject of extrapolation is more appropriately addressed in policy and guidance material and is, therefore, not addressed in these rules.

One commenter recommends a series of changes to Parts 91 and 135 dealing with operation of rotorcraft in icing. It is acknowledged that the operational rules should allow for operation of icing-certified rotorcraft in icing conditions. Notice 80–25 and this amendment deal primarily with certification criteria, and it is planned to address operational proposals in a subsequent notice as described in the background information to Notice 80–25. The commenter's recommendations relative to operation of rotorcraft in icing, therefore, are deferred until issuance of the operations notice.

One commenter states that the wording, "the rotorcraft must demonstrate", in §§ 27.1419(b) and 29.1419(b) gives the impression that the rotorcraft is capable of conducting a demonstration all by itself. The wording is clarified to eliminate this interpretation. This paragraph will begin with the words, "It must be demonstrated that. . . ." Although this wording does not appear in comparable sections of Parts 23 and 25, this requirement for demonstration is included in the rotorcraft rules to make it clear that the applicable requirements must be shown by actual demonstration. The commenter also points out that the term "flight envelope" in airplane certification rules refers to the maneuvering and gust envelope. Accordingly, the first sentence of §§ 27.1419(b) and 29.1419(b) is clarified to specify that the icing capability of the rotorcraft must be demonstrated and that this applies within the altitude envelope of the rotorcraft. As noted previously, this altitude envelope must be operationally practical.

Two commenters recommend changes to §§ 27.773, 29.773, 27.1093, 29.1093, 27.1323, 29.1323, 27.1325 and 29.1325 of the certification rules dealing with ice protection. The recommended changes would make these sections compatible with the icing certification requirements of §§ 27.1419 and 29.1419. The icing criteria references in §§ 27.1419 and 29.1419 are appropriate for IFR pitot-static system protection, but would be an excessively stringent design criterion for VFR approval under §§ 27.1323, 29.1323, 27.1325, and 29.1325. The compatibility of §§ 27.773, 29.773, 27.1093, and 29.1093 will be addressed in subsequent notices.

One commenter expresses the opinion that the wording of proposed §§ 27.1419(a) and 29.1419(a) could restrict a manufacturer from installing any anti-icing equipment on a helicopter unless complete icing certification is obtained for the helicopter. Identical wording as contained in the present fixed wing rules does not restrict manufacturers from installing such equipment. Installing equipment on a "no-hazard" basis has been allowed, even if the installation did not result in an operational approval. Also, the wording proposed by the commenter impinges on operational considerations, while this rule deals with certification requirements. This comment, however, raises a valid issue and wording in §§ 27.1419(a) and 29.1419(a) is changed to more accurately reflect that these requirements apply to rotorcraft for which full certification in icing conditions is desired.

One commenter states that §§ 27.1419(c) and 29.1419(c) imply that "complete" flight testing is required in measured natural atmospheric icing conditions in addition to testing by one or more other methods. The commenter expresses the opinion that this requirement is unreasonable. The rules clearly allow compliance by a variety of methods, provided they include flight tests in measured natural conditions to validate results obtained elsewhere. There is no inference of "complete" flight testing in measured natural conditions in this rule. If complete flight testing were prescribed, there would be no benefit or need to include other methods. The amount of flight testing required in measured natural conditions versus other methods will depend to a large extent on the substantiating data provided by the applicant in each particular certification program. The icing certification rules prescribe minimum safety criteria and permit reasonable flexibility in meeting these requirements. The FAA is aware of the time and expense involved in attaining icing certification. Substantial research and developmental effort and funding have been invested by the FAA over the past several years to reduce the time and cost associated with icing certification, and considerable progress has been made toward this goal. This commenter also proposes revising §§ 27.1419(c) and 29.1419(c) to permit certification by one or more methods, including flight tests in natural conditions. This proposal is unacceptable as it would permit icing certification without flight testing in natural conditions. At our current level of technology, some flight tests in natural conditions are an essential, minimum safety requirement and are necessary to validate results from other methods. In view of the foregoing considerations, the FAA disagrees that this requirement is unreasonable and this proposal is adopted without substantive change.

It is noted by one commenter that the proposed wording of §§ 27.1419(d) and 29.1419(d) is redundant in that rotors are included in the definition of airframe in Part 1. The FAA concurs and the words "and rotor systems" are deleted in the final rule.

Another commenter indicates that Subpart E presently contains all the icing requirements for the engine installation, and that the wording of the proposed §§ 27.1419(d) and 29.1419(d), which state "certain additional provisions of Subpart E of this part may be applicable", is subject to misinterpretation. The FAA concurs, and the revised wording suggested by the commenter is adopted. It is noted for clarification, however, that the revised wording does not preclude testing the engine installation for actual flight icing conditions that may present a hazard to engine operation, such as ingestion of ice shed from the rotorcraft.

One commenter recommends that the proposed § 27.1419 be written so that, if a small helicopter were to be approved in IFR or icing conditions, the total rotorcraft would be certificated under Part 29 as a transport category rotorcraft. Small helicopters have been successfully certified and operated in IFR conditions. Updated IFR certification rules for Part 27 rotorcraft are adopted as Appendix B of that part. The icing certification rules for Parts 27 and 29 rotorcraft are identical. However, to require small helicopters to comply with Part 29 transport category rules could impose rules which may be inappropriate and unnecessarily burdensome for small rotorcraft. Compliance with the IFR and icing rules of Part 27 would provide an adequate level of safety for small rotorcraft. Accordingly, proposed § 27.1419 is adopted without substantive change.

ECONOMIC SUMMARY

The FAA conducted an evaluation of the economic impact of these regulatory changes. A copy of the evaluation has been placed in the docket. The findings of this evaluation are summarized below.

Applicability—Category A Performance Requirements

This change would require new design rotorcraft with 10 or more passenger seats to be multiengine and have category A performance in parts of the flight regime.

The FAA concludes that this change will impose no additional costs on the private sector for the following reasons:

1. Industry sources state there has not been a demand for new design single-engine rotorcraft configured to carry 10 or more passengers and none is expected in the future. Therefore, manufacturers have elected to develop only twin-engine designs for helicopters configured for 10 or more passengers. This rule formalizes current industry practice without restricting either operators or manufacturers since single-engine helicopters are being and will continue to be produced under current type certificates and modifications. Therefore, there will be no economic burden on either manufacturers or operators and passengers will realize additional safety benefits.

2. This change will require an increase in installed power from what is generally available in current models, but any helicopter type certificated under this change would be likely to have the necessary installed power whether or not the change is enacted. No

helicopter could be type certificated under this changed rule before 1985, and Figure A shows that, because of the general industry trend toward increased installed power, new model helicopters will meet the requirement before a new helicopter could be type certificated under the change.

The FAA concludes that this rule change will have safety benefits which are difficult to quantify. A review of the available rotorcraft accident data shows that if category A performance had been available, it may have prevented nine past accidents. However, since the change applies only to new model rotorcraft, it would not prevent similar accidents of present model rotorcraft in the future.

Applicability—Other Changes.

The removal of height-velocity as a limitation for under-10-passenger-seat applications will provide additional flexibility to helicopter operators at no cost. This change will increase the productivity of rotorcraft in such applications, but the value of that productivity increase is unquantifiable. In some cases, to comply with the current rule, operators have to reduce productivity of a flight by reducing payload or decreasing fuel. This change eliminates the need for such adjustments.

Removal of the 20,000-pound weight limit for category B could result in increased revenues for operators if current rotorcraft models are requalified at higher weights. FAA estimates the value of the revenue increases at $5 million to $13 million per year from 1982 through 1989 for a total of $62.7 million with a net present value of $43.0 million. New large helicopters will also have the benefit of this increased weight capability.

IFR Certification Standards (Parts 27 and 29).

The instrument flight rules (IFR) certification standards will impose no new costs on helicopter operators and manufacturers. IFR certification is currently administered through "Interim Standards" which contain similar requirements to those in this amendment. Moreover, the rule change permits helicopter modifiers and operators to obtain approvals for IFR operation, and approvals under the rule change will reduce the regulatory burden because they will be broader in scope than current SFAR 29 approvals, will be sought less frequently, and will include no recurrent requalification features. This rule change will also permit manufacturers of small helicopters to obtain IFR certification at a slightly lower cost than under the current "Interim Standard" due to relaxation of requirements in some areas. There is, therefore, only a small, unquantified economic benefit in adopting this rule.

Since this rule change essentially formalizes the regulatory mechanism for obtaining IFR certification, it is not expected to result in any quantifiable safety benefits.

Icing Certification Standards (Parts 27 and 29).

The icing certification standards in this amendment provide regulatory guidance on how to obtain an additional level of operational capability. A helicopter operator, therefore, will weigh this increased operations capability against increased production costs that will be factored into the purchase price of the aircraft. In the past, the FAA has developed special conditions to certify rotorcraft for icing conditions. Issuing special conditions is a time-consuming process. Proposed special conditions are published in the *Federal Register*, comments are analyzed, and then a final document is issued and published.

These amendments incorporate standards currently contained in special conditions into the FAR icing certification rules. If this icing rule were not adopted, those special conditions would continue to be administered for icing approval. Therefore, this rule will have only a positive economic impact for manufacturers, operators, and the FAA. A manufacturer will incur the costs of obtaining icing approval only if it has determined that marketing benefits outweigh production costs and it wishes to have its helicopters certificated for operation in icing conditions. Both manufacturers and operators are likely to find icing certification advantageous from both a marketing and utilization standpoint because it would allow full use of the IFR capabilities of the rotorcraft.

Icing certification will allow increased utilization and will have an unquantifiable safety benefit. It will reduce the risk of accidents during flight in icing conditions. Because of increasing rotorcraft operations, exposure to these conditions may increase greatly in the future.

SUMMARY OF BENEFITS AND COSTS
[Millions of 1983 dollars]

	Benefits	Costs	Benefits/cost ratio
10 or more passengers, category A	Improved Safety	Negligible	Not applicable
Remove height-velocity limitations	Increased productivity; Unquantifiable Revenue Benefit.	Negligible	Not applicable.
Remove 20,000 lb. limitation	$62.7 (7 years) (or $43.0 present value)	Negligible	Not applicable.
IFR certification	Reduced regulatory burden; Small, unquantifiable economic benefit.	Negligible	Not applicable.
Icing certification	Increased utilization resulting in increased operator revenues.	Negligible[1]	Not applicable.

[1] Cost negligible since icing certification is not mandatory. However, manufacturers' costs of icing certification will be offset by increased sales to operators wishing to utilize rotorcraft in icing conditions.

Regulatory Flexibility Determination

A final regulatory flexibility analysis of this amendment is not necessary since Notice 80-25 was issued before January 1, 1981. However, the overall imputs of the amendments should not be adverse for small entities.

ADOPTION OF THE AMENDMENT

Accordingly, Parts 1, 27, and 29 of the Federal Aviation Regulations (14 CFR Parts 1, 27, and 29) are effective March 2, 1983.

[Sections 313(a), 601, 603, and 604 of the Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421, 1423, and 1424); Section 6(c) of the Department of Transportation Act (49 U.S.C. 1655(c)).]

NOTE: The FAA has determined that the benefits of this amendment, in providing an increased level of safety to passengers traveling in rotorcraft while at the same time recognizing and providing for the unique qualities and capabilities of rotorcraft, far outweigh the burdens and that this amendment: (1) involves a regulation which is not a major rule under Executive Order 12291; and (2) is not a significant rule under the Department of Transportation Regulatory Policies and Procedures (44 FR 11034; February 26, 1979). A final regulatory evaluation prepared for this action is contained in the regulatory docket. A copy of it may be obtained by contacting the person identified under the caption "FOR FURTHER INFORMATION CONTACT."

Amendment 27-20

Aircraft Engine Regulatory Review Program; Aircraft Engine and Related Powerplant Installation Amendments

Adopted: December 16, 1983 **Effective: March 26, 1984**

(Published in 49 FR 6832, February 23, 1984)

SUMMARY: This amendment updates the airworthiness standards applicable to the type certification of aircraft engines and of aircraft with respect to engine installations. The changes implement the President's Regulatory Reform Program by simplifying a number of technical requirements, by eliminating unnecessary rules where appropriate, and by removing administrative burdens on regulated persons and the FAA through amendment of regulations from which exemptions have been granted. The regulations update and modernize technical requirements to reflect engineering advances in the state-of-the-art and take into account accumulated service experience and recommendations of the National Transportation Safety Board (NTSB).

FOR FURTHER INFORMATION CONTACT: George F. Mulcahy, Engine and Propeller Standards Staff, ANE-110, Aircraft Certification Division, New England Region, Federal Aviation Administration, 12 New England Executive Park, Burlington, Massachusetts 01803; telephone: (617) 273-7330.

SUPPLEMENTARY INFORMATION:

BACKGROUND

Following recodification in 1965, the first significant revision to the Code of Federal Regulations (CFR) Title 14, Part 33—Airworthiness Standards: Aircraft Engines, was made late in 1974 by Amendment 33-6. The amendment sought to accommodate the increasing complexity of airframes and engines and their interfaces and the further impact of supersonic flight. During ensuing years, as the industry became even more complex and specialized, the need for clarification and elimination of redundancies in test and design requirements became evident.

Responding to these needs, the FAA in mid-1977 announced an Aircraft Engine Regulatory Review Program, solicited rule change proposals from the aviation and general community, and held a week-long Regulatory Review Conference in January 1978, attended by over 100 industry and public representatives.

Based on information received during the review program and conference, the Administrator issued Notice of Proposed Rulemaking (NPRM) 80-21, Aircraft Engine Regulatory Review Program; Aircraft Engine and Related Powerplant Installation Proposals (45 FR 76872; November 20, 1980), which proposed to upgrade the airworthiness standards applicable to the type certification of aircraft engines and of aircraft with respect to engine installations. Comments on the proposals were invited until February 18, 1981.

Interested persons now have been given an opportunity to participate in the making of these amendments, and due consideration has been given to all matters presented. The proposals and comments are discussed below. Substantive changes and changes of an editorial and clarifying nature have been made to the proposed rules based upon relevant comments received and further review within the FAA. Except for minor editorial and clarifying changes and the substantive changes discussed below, these amendments and the reasons for them are the same as those proposed and explained in Notice 80-21.

DISCUSSION OF COMMENTS

The following discussion summarizes the comments received from the public, from industry, and from foreign authorities. Proposals are numbered as in Notice 80-21.

Proposal 1. This amendment clarifies § 23.901(d), which calls for a determination that installation effects do not cause any deterioration of powerplant rain ingestion tolerance as demonstrated by the engine in compliance with the engine certification standards of § 33.77.

One commenter advises that it is not clear whether a specific determination for deterioration of powerplant rain ingestion tolerance is required for the intake-engine combination or whether the test of Part 33 would suffice. The intent of the proposed rule is to ensure that installation effects do not result in any deterioration of powerplant rain ingestion tolerance. This requires a separate determination for the engine installation, other than that required by 14 CFR Part 33.

A commenter recommends that flight idle be included in the evaluation of operation in rainfall conditions. The FAA agrees that the regulation, as proposed, does not specify operating conditions for the rain ingestion investigation and the operating conditions of takeoff and flight idle are added to the rule as adopted.

One commenter recommends that the specified liquid water content be compared to engine induction airflow rate. It is the intent of the regulation to proportion the ingested liquid water content in relation to the induction airflow, and this recommendation would afford clarification. Therefore, the proposed rule is revised by adding the phrase "4 percent of engine airflow by weight."

A commenter recommends that the requirement for 3 minutes of operation at flight idle in rain be deleted. The FAA disagrees. Satisfactory operation of an engine for 3 minutes at flight idle in the rain conditions specified will provide assurance that it will satisfactorily operate throughout the rain conditions likely to occur in service. The 3-minute time period is therefore retained.

A commenter recommends that the regulations be clarified by removal of words such as "safe" and "hazardous," which are considered ambiguous. The FAA believes that these words have a common interpretation in aviation and that § 23.901 is sufficiently clear without further change.

Proposal 2. This amendment to § 23.903(a) permits the installation of an engine approved under standards other than those of 14 CFR Part 33, such as Part 13 of the Civil Air Regulations (CAR) or Part 21 of the Federal Aviation Regulations (FAR). In addition, provision is made for approving installation of a type certificated engine on the basis of satisfactory service experience if the engine has not specifically complied with § 33.77. Proposed § 23.903(b) also will require that precautions be taken in the design of aircraft to protect vital components from the effects of uncontained rotor failures and engine fires.

Four commenters request that § 23.903(a) be revised to include reference to § 21.29(a) (1) (ii), which pertains to certification of import products. To be eligible for installation in a U.S. type certificated aircraft, an engine must have a U.S. type certificate. Engines imported from a foreign country type certificated in accordance with § 21.29 are covered by the amended wording of § 23.903(a), and no further action is required.

One commenter advises that under the proposed wording of § 23.903(a) (2) (i) existing engines could be disqualified each time § 33.77 was amended, a condition which would be unreasonable. The intent of this rule change is to ensure an acceptable level of safety for all engine installations with relation to foreign object ingestion (FOI). A certificated engine which has shown compliance with an approved standard and has had a satisfactory FOI service history when installed in a similar aircraft location will continue to be eligible for installation in an aircraft under paragraph (a) (2) (ii). Therefore, no further change to the proposed rule is necessary.

A commenter advises that the proposed wording of § 23.903(a) (2) (ii) would deny an applicant the right to apply service experience from a particular aircraft engine installation to justify certification at a different location on the aircraft. The commenter states that there is no proof that some installation locations have a higher frequency of ingestion than others, wing mounted versus aft mounted, for example, nor has frequency of ingestion been found to be related to engine capability to withstand ingestion of objects. FAA policy is to certify engines independently of installation location and/or number of engines per aircraft. Nevertheless, when satisfactory service experience is used as a basis of approval of an engine installation, the location of the engine during the time this experience was accumulated must be considered to determine whether the new installation is more or less subject to FOI, and whether similar results may be expected in the proposed installation. This policy is adequately expressed in the proposal, and no further change is necessary.

One commenter recommends clarifying § 23.903(a) with a third qualifying condition: that the engine be shown to comply with § 33.77 in effect at the time of engine type certification. The FAA has determined that addition of a third alternative might result in an unacceptable level of safety under FOI conditions. Section 33.77 in effect October 1, 1974, or thereafter is specifically referenced to preclude this eventuality.

A commenter recommends that § 23.903(b) be revised to specify the areas needing protection from rotor burst, such as fuel systems, flight control systems, and occupied areas of the fuselage. The FAA notes that areas which may be critical in one aircraft with respect to the effects of rotor burst may not be critical in another. Accordingly, it is left to the designer to determine which areas must be protected and how to protect them, and the proposed general language provides such latitude. However, the FAA will evaluate such design for compatibility with the intent of this regulation.

One commenter objects to the wording of the proposed regulation and does not consider turbine engine rotor failure or casing burn-through a problem for small aircraft engines. Turbine engine rotor failure has been reported in small turbine engines, although problems have not been noted in recent years. As long as the potential for failure continues to exist, however, the problem should remain under consideration. Measures taken to protect aircraft from effects of rotor burst also are expected to resist burn-through. Proposed § 23.903(b) as drafted ensures protection appropriate to the risk involved and is therefore adopted as proposed.

Proposal 3. This amendment revises existing § 23.905 to allow installation of a propeller approved under standards other than 14 CFR Part 35. Commenters agree with this rule change. Therefore, except for deletion of the qualifier "approved," which is not applicable in reference to a type certificate, the rule is adopted as proposed.

Proposal 4. This amendment to § 23.975(b) requires that each fuel injection engine employing vapor return provisions, as well as carburetor engines having such provisions, have a separate vent line to return vapor to the vapor space in one of the fuel tanks. Four commenters recommend that the proposed regulation be revised to require fuel vapor to be returned to the fuel tank but not specifically to the vapor space, provided the return line location is carefully selected. However, carburetors with vapor elimination features currently in service have a very low return fuel pressure with which to overcome flow resistance in the line, so that the static fuel pressure head at a particular location might be sufficient to prevent proper venting of the carburetor. Also, discharging the vapor return line into the fuel tank at a location near the fuel tank outlet could result in vapors being reintroduced to the engine with subsequent loss of power. The proposed amendment is changed in accordance with these comments to specify that the vapor be returned to the top of one of the fuel tanks.

One commenter recommends that it would be preferable to return the vapor to the selected tank (the tank being used). The FAA agrees but considers this requirement to be a substantial change which would add significant complexity and cost to the fuel system of airplanes certificated under Part 23 without a commensurate increase in safety.

Proposal 5. This amendment to § 23.994 redefines the required protection against fuel spillage in terms of that occurring after wheels-up landing on a paved runway. One commenter questions whether any amount of fuel spillage should be allowed during a wheels-up landing. Another suggests that a specified amount of spillage would be more appropriate. The FAA agrees that it would be desirable to prevent any fuel spillage during a wheels-up landing on any type of landing surface, but it also recognizes that release of minute quantities of fuel would not be likely to present a fire hazard and that complete avoidance of fuel spillage or approval of a specific amount would be very difficult. Therefore, the regulation is adopted as proposed.

Proposal 6. This amendment adds a new § 23.995(g) specifying that fuel tank selector valves must take a separate and distinct action to place the selector in the "OFF" position and that the selector must not pass through the "OFF" position when changing from one tank to another.

One commenter recommends that the proposed wording be changed to read "The valve shall be designed so that it is not necessary to move the selector through 'OFF' position when switching tanks." The FAA believes that the proposed phrasing is more positive, and the rule is adopted in this form. This change is in accordance with National Transportation Safety Board (NTSB) Safety Recommendation No. A-79-72.

Proposal 7. Part of the proposed amendment to § 23.997 was intended to make it clear that an aircraft manufacturer need not duplicate equipment or tests of fuel strainers or filters if they were provided and approved as part of a certificated engine and if they also meet the requirements of this subpart. The proposed wording, however, inadvertently exempted such provided equipment from the latter requirement. The intended relief is already provided as an option to aircraft and engine manufacturers under the current rule. Therefore, the portion of the proposed rule exempting engine-supplied devices is withdrawn.

The rule also corrects terminology and relieves design requirements for mounting fuel strainers or filters.

Commenters question the meaning of the words "fuel metering device," recommend that filtration standards be included for the filters/strainers, and recommend that the fuel filter be placed ahead of any other fuel system component subject to contamination. The FAA has determined that a fuel metering device is commonly understood to be one which regulates or "meters" fuel flow and that fuel filtration standards should not be included in the regulation but covered by policy material. The rule, in conjunction with § 23.977, assures that filters and strainers are properly located to prevent contaminants from blocking components other than pumps and controls. In some installations the suggested locations would in fact be unfeasible.

Proposals 8 and 9. The proposed changes to §§ 23.1013 and 23.1015, which deal with oil tanks approved and provided as part of an engine, are withdrawn for the same reasons given in Proposal 7 for withdrawing the portion of the wording exempting engine-supplied devices.

Also, a commenter questions whether an equivalent provision originally proposed for Part 25 applies to engines certificated to the standards of Part 33 before Amendment 33-6 and suggests that this be clarified. The commenter asserts that the oil tanks may be unsafe if not substantiated under Amendment 33-6. The concern expressed by the commenter has been taken into account by withdrawing the proposal.

Proposal 10. This change to § 23.1019 corrects terminology and is intended to relieve the airplane manufacturer from duplicating compliance with oil strainer/filter design requirements if they are provided and approved as part of the engine to be installed. The proposed rule, except for that portion which corrects terminology, is withdrawn for the reasons given in Proposal 7.

One commenter recommends that oil filtration standards be included in the regulations. The FAA believes that filtration standards would be more appropriately covered by an advisory circular or equivalent advisory information.

Proposal 11. This proposal amends § 23.1021 to permit the use of multiple oil system drains, if necessary, to provide more efficient drainage. All commenters agree with the change, and the regulation is adopted as proposed.

Proposal 12. The proposed change of § 23.1093 brings the ground idle induction system icing test conditions into conformance with Appendix C of 14 CFR Part 25 and permits periodic operation at increased power or thrust higher than ground idle as an ice protection measure.

One commenter questions whether "momentary operation at takeoff power" is adequate. Another commenter questions whether allowing engine runup on an icy taxiway would be a safe condition. The FAA agrees that the second comment may have merit under certain conditions. However, the relaxatory nature of this part of the regulation need not be denied applications where safety is not compromised. On icy runways, the decision to use momentary power or thrust to remove induction ice would remain with the flightcrew. The first comment addresses part of the current regulation not raised under Notice 80-21 and therefore is outside the scope of the proposed change.

One commenter recommends a referenced military specification, MIL-E-5007D, which would be a somewhat more severe requirement (25°F, mean effective drop diameter 30 microns, and .4 grams per cubic meter liquid water content). Actual meteorological data, as presented at the Aircraft Engine Regulatory Review Conference, does not support this severe a requirement. It is considered that the revised test criteria take into consideration actual ground icing conditions, including an adequate margin of safety, and that compliance with MIL-E-5007D is not warranted. Therefore, § 23.1093 is adopted as proposed.

Proposal 13. This proposed change would add a new § 23.1143(e) to: (1) state engine control requirements not only for antidetonant injection (ADI) systems, but for other fluid injection systems (other than fuel) as well; (2) make it clear that any fluid injection system and its controls provided and approved as part of the engine need not be duplicated by the aircraft manufacturer; and (3) specify a separate control for fluid injection pumps.

Five commenters object to proposed § 23.1143(e) (1) on the grounds that it restricts design of fluid control to one of a number of satisfactory types. It is their view that fluid injection requirements are influenced by other factors which may not relate to the amount of power produced by an engine in service. In some cases, the engine installations have fluid systems that do not vary the fluid flow with power. Fluid is injected in a fixed amount, and power is varied by the engine fuel control via the power lever. The proposed paragraph is rephrased to permit more flexibility in design.

One commenter requests that the regulations be clarified so that separate control for fluid injection pumps is required regardless of whether or not the injection system is approved as part of the engine. Another suggests deletion of this paragraph as some current systems do not use pumps. The FAA agrees with the commenters, and the proposed regulation is revised accordingly.

The portion of the proposed rule exempting engine-supplied devices from the requirements of this section is withdrawn for the reason given for § 23.997.

Proposal 14. This amendment revises § 23.1163(a) to make it clear that it is the ultimate responsibility of the aircraft manufacturer who installs an engine to assure proper sealing of engine oil lubricated accessories.

Three commenters request clarification of paragraph (a) (3) to define what is to be sealed. The FAA concurs that the intent is unclear and proposed paragraph (a) (3) is changed to define the extent of sealing.

Proposal 15. The amendment to § 23.1183 would raise the limiting capacity of reciprocating engine oil sumps from 20 to 25 quarts before fireproofing or shielding is required. Also, the regulation exempts components, as well as lines and fittings that have been approved as part of the engine, from these requirements. These changes remove unjustified engine design limitations and afford increased range capabilities.

One commenter recommends that the 20-quart capacity limit required by paragraph (a) be retained. The proposal is seen as an arbitrary accommodation of a particular application for type certification, but the commenter does not supply specific information or data to support this claim. A search of FAA records has not disclosed such an application.

Neither service with 20-quart capacity oil systems nor any other evidence has shown that there would be any compromise of safety associated with a sump capacity of 25 quarts of oil as opposed to 20 quarts in the case of a powerplant fire. The amendment is adopted as proposed.

Proposal 16. This amendment to § 23.1189(a) (1) and (b) (2) clarify the requirements for shutoff means for flammable fluids in multiengine aircraft and for turbine engine oil systems.

One commenter recommends that this rule be cross-referenced to 14 CFR Part 33. Another commenter suggests addition of the word "installation" to paragraph (a) (1) for the sake of clarity.

The FAA does not consider a cross reference to Part 33 necessary since the emphasis of this section is upon the aircraft manufacturers' responsibility to ensure a fireproof engine installation. Adding the word "installation," however, will provide additional clarification. The proposed regulation is adopted with this change.

Other comments contain proposals for Part 23 which were not on the agenda of the Aircraft Engine Regulatory Review Program. These include the addition of a new § 23.907 concerning acceptable propeller stress levels and addition of a rule requiring that positive pressure be maintained within fuel tanks to prevent vapor formation. These recommendations are outside the scope of the proposed amendment and are not addressed by this rulemaking.

Proposal 17. This revision of § 25.33(a) (2) corrects and updates an obsolete reference to the rules and does not constitute a substantive change. No unfavorable comments were received, and the proposal is adopted.

Proposal 18. No unfavorable comments were received with respect to revising § 25.697(a) to correct reference to obsolete rules. The proposal is therefore adopted without change.

Proposal 19. For a discussion of comments on the proposed amendment to § 25.903(a), see the proposal for § 23.903(a).

Proposal 20. This proposal revises § 25.905(a) to allow installation of a propeller type certificated under the procedures of CAR Part 14 or § 21.29 of the FAR, as well as Part 35 of the FAR. No unfavorable comments were received with respect to revising § 25.905(a). Therefore, except for deletion of the qualifier "approved," which is not applicable in reference to a type certificate, the rule is adopted as proposed.

Proposal 21. Six commenters object to and recommend deleting the proposed change to § 25.939(b). The consensus is that determination of surge and stall margins in quantitative terms is beyond the current state-of-the-art and that adequate investigation of engine stall, surge, and flameout characteristics is currently covered by the requirements of § 25.939(a). Therefore, the proposed change to § 25.939(b) is withdrawn. The comparable proposal to amend § 33.65 also is withdrawn.

Proposal 22. This amendment to § 25.961 restores test conditions for hot weather fuel system operation previously deleted.

One commenter recommends deleting proposed paragraph (a) (4) (i) (D), arguing that the center of gravity is not relevant to hot fuel tests. This reference to the most unfavorable center of gravity was continued over from the deleted § 25.65(a) (4) as one of the conditions for demonstrating all engine climb in cruising configuration. The FAA agrees that unfavorable center of gravity is not relevant to the hot fuel test, and paragraph (a) (4) (i) (D) of the proposed change is deleted. The proposed amendment is adopted as revised.

Proposal 23. For a discussion of comments on and disposition of the proposed amendment to § 25.994, see the proposal for § 23.994.

Proposal 24. For a discussion of comments on and disposition of the proposed amendment to § 25.997, see the proposal for § 23.997.

Proposal 25. The proposed revision of § 25.1001 removes the distinction between fuel jettisoning systems for reciprocating and turbine engine-powered airplanes, deletes obsolete sections, and corrects references to climb performance sections. Other changes are editorial in nature, eliminate redundancies, and clarify the text.

No unfavorable comments on the proposed change of § 25.1001 were received. However, two commenters recommend rephrasing the requirement of paragraph (d) (3) to specify that fuel or fumes do not enter any part of the airplane in sufficient quantity to constitute a fire or explosion hazard, maintaining that not all fuel or fumes necessarily constitute a fire or explosion hazard. A third commenter recommends revising paragraph (b) to rectify a condition in which the intended reduction in airplane weight cannot be achieved when jettisoning is initiated with the fuel quantity and distribution associated with takeoff at maximum zero fuel weight (that is, for short range with high cabin load).

Fuel or fumes should not be allowed to reenter any part of the airplane during an emergency condition such as jettisoning. It would be difficult to establish the amount of fuel or fumes that does constitute a hazard. Regarding the wording in paragraph (b), the FAA agrees that the comment has merit; however, it is outside the scope of the proposed change. The rule is adopted as proposed.

Proposals 26 and 27. No unfavorable comments were received in response to the proposed changes to §§ 25.1013 and 25.1015. However, the portion of the proposals dealing with oil tanks provided and approved as part of an engine is withdrawn for the reasons stated for § 23.997. For a discussion of reciprocating engine oil sump capacity in relation to fireproofing requirements in § 25.1013, see the proposal for § 23.1183.

Proposal 28. No adverse comments were received on the proposal to amend § 25.1019, and the change is adopted as proposed. For a discussion of this change, see the proposal for § 23.1019.

Proposal 29. No adverse comments were received on the proposal for § 25.1021, and it is adopted as proposed (See the proposal for § 23.1021).

Proposal 30. This amendment to § 25.1045(d) corrects references to performance requirements which have become obsolete. In addition, a commenter would delete the cooling test configuration center of gravity requirement as irrelevant. Another commenter suggests the following rewording: ". . . the most unfavorable center of gravity position at which the airplane can be flown safely."

Reference to the most unfavorable center of gravity was carried over from deleted § 25.67, which governed demonstration of one engine inoperative climb. Section 23.121(c) is the new reference, and it has no requirement for center of gravity position. In any case, the airplane must be flown within the airplane limitations.

The FAA agrees that for this cooling test the effect of center of gravity position is negligible and does not affect the outcome. The proposed amendment is revised and adopted.

Proposal 31. This amendment to § 25.1091(e) requires the foreign object ingestion criteria of § 33.77 to be applied to vulnerable portions of induction systems.

Comments received were generally favorable. Two commenters recommend, however, that additional wording be included to specify the air induction system parts or components to be considered under this rule.

The FAA believes that the proposed change adequately states the performance objectives of the airplane air induction system and the criteria to be applied. Listing specific components to be protected would ignore possible future developments. The change to § 25.1091(a) therefore is adopted as proposed.

Proposal 32. For a discussion of comments on and disposition of the proposed amendment to § 25.1093(b) (2), see the proposal for § 23.1093(b) (2).

Proposal 33. For a discussion of comments and disposition of the proposed amendment to § 25.1143(d), see the proposal for § 23.1143(e).

Proposal 34. For a discussion of comments on and disposition of the proposed amendment to § 25.1163(a), see the proposal for § 23.1163(a).

Proposal 35. For a discussion of comments on and disposition of the proposed amendment to § 25.1183(b) (1), see the proposal for § 23.1183(b) (1).

Proposal 36. For a discussion of comments on and disposition of the proposed amendments to § 25.1189(a) (1) and (2), see the proposals for § 23.1189(a) (1) and (b) (2).

Proposal 37. This amendment would have deleted § 25.1305(d) (3), which calls for a rotor system unbalance indicator in each turbojet installation.

One commenter disagrees, stating that the requirement should be retained and arguing that foregoing the monitoring of airborne vibration would be a retrograde step. The commenter claims that well developed systems have shown more than adequate reliability and are considered capable of giving advance warning of impending failures.

Service experience has not shown that installation and use of airborne vibration monitor (AVM) systems are universally beneficial, as they are not totally effective in providing advance warning of all hazardous engine failure modes. However, recent experience, since this amendment was proposed, has demonstrated the potential of an AVM to provide a safety improvement as discussed by the first commenter. Therefore, the proposal to delete § 25.1305(d) (3) is withdrawn pending further study.

Proposal 38. No unfavorable comments were received regarding the proposed change to § 25.1323(b) (2), which deletes an obsolete reference to § 25.59, and it is adopted without change.

Nonsubstantive changes are made to §§ 25.1359 and 25.1521 which were not included in the Regulatory Review Conference Agenda or in Notice 80-21. These amendments correct typographical errors and references.

Proposals 2 and 19 modify §§ 23.903(a) and 25.903(a), respectively, to require an "approved type certificate" for each engine installed, rather than a type certificate issued under Part 33 only. The discussion presented for the proposal for § 23.903(a) also applies to §§ 27.903(a) and 29.903(a). Therefore, substantively identical changes to these actions are adopted.

A commenter suggests that in connection with the revised wording, turbine engines installed in rotorcraft should be required to comply with the foreign object ingestion requirements of § 33.77, which is now the case for engines type certificated after October 1, 1974. For engines for which application for type certificate was made before that date, this suggestion constitutes a substantive change beyond the scope of this rulemaking and is not adopted.

Proposal 39. For a discussion and disposition of the proposed amendment to § 27.997, see also the proposal for § 23.997.

One commenter questions the rationale behind deleting the phrase "and the mesh" and claims that without this phrase only filter capacity is addressed by the rule. The term "mesh" is not applicable to filters or filter elements. However, fuel filtration requirements, including mesh, particle size, and density, if not satisfied by the engine manufacturer, will be prescribed in the instruction manual for installing and operating the engine (§ 33.5). Therefore, in this case, compliance would be assured by reference to § 33.5 in § 27.901(c) (1) and the requirements in § 27.977 (§§ 29.901(b) (1) (i) and 29.977 for Part 29).

Proposals 40, 41, 42 and 43. For discussion and disposition of the proposed amendments to §§ 27.1013, 27.1015, 27.1019, and 27.1021, see the proposals for §§ 23.997, 23.1019, and 23.1021.

Proposals 44 and 54. These proposals would delete §§ 27.1093(b) (2) and 29.1093(b) (2), which are the current requirements for demonstrating satisfactory powerplant operation when exposed to atmospheric icing during ground operating conditions. The basis for deletion is the contention that engine induction system icing during ground idle operation has not been a significant problem with rotorcraft, assuming they are not required to queue up for takeoff as are airplanes. Subsequent FAA review of rotorcraft utilization discloses that extended ground operation of rotorcraft during icing conditions, although infrequent, must be expected. The proposals to delete §§ 27.1093(b) (2) and 29.1093(b) (2) therefore are withdrawn and the sections are reworded as in §§ 23.1093(b) (2) and 25.1093(b) (2).

For further discussions on this amendment, see Proposal 75 for § 33.68 and Proposal 12 for § 23.1093.

Proposals 45 and 55. These amendments add new §§ 27.1143(d) and 29.1143(d) and (e) specifying that fluid injection (other than fuel) controls be in the throttle controls and eliminating duplicate certification requirements, as in §§ 23.1143 and 25.1143. However, the term "throttles" is a misnomer for modern turbine engines installed in rotorcraft. Changes needed to rectify the terminology would be beyond the scope of this review. The proposals to amend §§ 27.1143 and 29.1143 are withdrawn and will be referred to the Rotorcraft Regulatory Review Program for consideration.

Proposals 46 and 56. For a discussion and disposition of the proposed amendments to §§ 27.1163(a) and 29.1163(a), see the proposal for § 23.1163(a).

Proposals 47 and 57. These amendments to §§ 27.1183 and 29.1183 establish a new capacity limit of 25 quarts instead of 20 quarts for reciprocating engine integral oil sumps before requiring the sumps to be fireproof or have fireproof shielding. For a discussion of comments on and disposition of the proposals, see the proposal for § 23.1183.

Proposals 48 and 58. For a discussion and disposition of the proposed amendments to §§ 27.1189 and 29.1189, see the proposal for § 23.1189.

Proposals 49, 50, 51, 52, and 53. For discussion and disposition of the proposed amendments to §§ 29.997, 29.1013, 29.1015, 29.1019, and 29.1021, see the corresponding proposals for Part 23.

Proposal 59. This amendment to § 33.7 revises the engine operating limit requirements for fuel and oil temperature and pressure, overhaul, and windmilling r.p.m.

All comments support adoption of this proposal. Additionally, two commenters propose changing Appendix A of Part 33 to be compatible with deleting the word "overhaul," as proposed in the amendments to §§ 33.7(c) (17) and 33.90. However, reference to the term "overhaul" is still appropriate to many turbine and basically all reciprocating engines. While the FAA believes there is merit in considering a restructuring of Appendix A, it goes beyond the scope of the Notice 80-21. Accordingly, the amendment is adopted as proposed.

Proposal 60. This amendment to § 33.14 revises and clarifies the rules establishing engine low-cycle fatigue limits.

One commenter suggests that the definition of start-stop cycle fails to account for reduced power takeoff and therefore should be modified to read ". . . accelerating to takeoff thrust levels . . ." rather than ". . . accelerating to maximum rated power or thrust. . . ." Reduced power takeoff is an operational procedure determined by prevailing factors such as aircraft weight, runway length, and density altitude. The FAA believes the fatigue life used for certification should be the minimum service life based on maximum ratings since the engine operational characteristics will vary for each aircraft installation. Both cyclic and hourly life credits for reduced stress levels experienced by some discs during reduced power takeoff can be adjusted by the use of approved methodology. One engine manufacturer has done so by creating "disc life factors" to apply to those cycles or hours of operation under required conditions. The established life thus has a certain conservative bias, as it is based on maximum ratings.

Another commenter objects to the proposed wording of this section because it eliminates the distinction between maximum predicted and initial service life and suggests that a part could continue in service up to its maximum predicted life without undergoing the specified sampling program. The commenter suggests that some fixed percentage of the predicted life be established as the initial service life. The FAA does not agree that a lack of distinction will exist between initial and predicted life. The predicted life of a disc is evaluated by the applicant using approved low-cycle fatigue methodology involving factors such as material properties, engine thermodynamics, etc., which when used in the analysis result in a confidence level for the predicted life. Based on this confidence level, the service life may vary from one-third to three-fourths or more of the predicted life. To require the initial service life to be a fixed proportion of the predicted life, i.e., 50 percent for instance, would place an undue burden on the applicant with no commensurate safety benefit. Any program to increase the initial service life must include sampling or inspection procedures. For these reasons, the rule, except for some editorial changes, is adopted as proposed.

Proposal 61. No unfavorable comment was received on the proposal to amend § 33.15(b) by deleting the phrase "or Technical Standard Orders," given erroneously as a standard for engine materials, and the proposal is adopted without change.

Proposal 62. This amendment to § 33.17 increases the limiting oil capacity for reciprocating engine integral oil sumps from 20 to 25 quarts before fireproofing is required.

One commenter takes exception to the wording of § 33.17(a), which implies that any structural failure or overheating in turbine engines would represent a hazardous condition. The same language has been carried under deleted § 33.17(f) and has presented no problems in interpretation.

A commenter recommends that the present 20-quart oil limit be retained, implying that it was established by fire testing. The FAA has no records which show that the 20-quart limit was derived from fire test data. Its original intent was to exclude the integral oil tanks of small reciprocating engines from fireproofing requirements, and it was based on years of satisfactory service experience. The FAA does not believe that raising this limit to 25 quarts as proposed will violate the original intent (see also the proposal for § 23.1183). Since the 25-quart limit was proposed over 4 years ago, the FAA has received no evidence that would indicate this change would compromise safety. Therefore, the amendment is adopted as proposed.

Proposal 63. This amendment to § 33.19(a) requires an applicant for an engine type certificate to define the trajectories of rotor blade fragments exiting outside compressor or turbine rotor cases.

Two commenters object to the last word of § 33.19(a) in that it is unduly restrictive. The commenters state that the requirement that fragment energy levels and trajectories be "defined" can be interpreted to mean precisely defined by tests, whereas in practice they may be determined by engine tests, component tests, and/or analysis. The FAA disagrees that use of the word "defined" is unduly restrictive. It is the FAA's intent that the boundary condition for possible fragments be set and therefore defined. The method used may include engine tests or other means acceptable to the Administrator.

Another commenter suggests that a corresponding change be made to § 33.5 to provide for the location of the data on fragment energy levels and trajectories. However, a change to § 33.5 is not required since the actual location of this data will be referenced on the engine data sheet.

Another commenter suggests a clarification of the rule is required to specify that only where fragments leave the engine through the inlet or turbine exhaust should the energy and trajectories be defined. The FAA believes this clarification is unnecessary. The first portion of the current rule requires containment of damage from blade failures. The new sentence would require definition of the boundary conditions for debris generated by the blade failure and ejected by the engine. It is this possible secondary damage due to debris exiting the inlet, fan, or core exhaust that is pertinent. Accordingly, the proposal is adopted without change.

Proposal 64. This revision of § 33.23 refines definitions and load limits for engine mounting attachments and structure.

Several commenters suggest changing § 33.23(b) to make the wording similar to the aircraft primary structural requirements of §§ 23.305(a) and (b) and 25.305(a) and (b). It is suggested that "permanent deformation in § 33.23(b) (1) be changed to "detrimental permanent deformation." This change would recognize the slight deformations associated with structural hysteresis which do not adversely affect the structure.

It is further suggested that any deformation at limit load which interferes with engine operation should not be permitted, although § 33.23 does not so state, and that the § 25.305, 3-second criterion for demonstration of ultimate load is also appropriate for

§ 33.23(b) (2); otherwise, the rule could be interpreted to require the structure to withstand ultimate load for an indefinite period of time.

The FAA believes that the primary structural requirements of § 25.305 are appropriate where a variety of designs serving the many structural needs of an aircraft must be evaluated under a single rule. Engine mounting attachment structure represents a much narrower range of design for which the additional provisions of § 25.305 are not needed. Current practice and service experience support this opinion. Therefore, the wording "permanent deformation" is retained.

One commenter would also specify that the engine mounting attachments and structure withstand repeated application of normal loads; that is, there should be fatigue substantiation of critical structural components. Although not currently required, engine mounting attachments and structures are in fact being confirmed under repetitive loading. Adopting this requirement would, however, add regulatory demands beyond those of the proposal. The question of requiring substantiation of mounting attachments and structures under cyclic loads will be considered for future rulemaking action.

One commenter suggests inserting the word "engine" in § 33.23(a) and (b) to modify "structure" and thus avoid implying that aircraft structure is meant. The FAA agrees, and the proposal is adopted with the wording changed accordingly.

Proposal 65. No unfavorable comment was received on the proposal to amend § 33.25 to delete an unnecessary sentence relating to load requirements already specified in § 33.49(a) and § 33.87(a) (6) for reciprocating and turbine engines, respectively. The amendment permits a minute amount of oil leakage from the engine interior and assigns ultimate responsibility for engine/accessory drive sealing to the aircraft manufacturer. Accordingly, the amendment is adopted as proposed.

Proposal 66. This amendment to § 33.27 revises overspeed test conditions and strength requirements for turbine, compressor, and turbosupercharger rotors and extends these criteria to fan rotors.

Two commenters object to the proposed wording of the posttest acceptability criteria in the last sentence, stating that it is unnecessarily loose and subject to varied interpretation. The FAA disagrees. The intent of the test is to ensure that compressor and turbine rotors have sufficient structural strength to provide reliability and safety during an inservice overspeed situation. The acceptability criterion is that parts show no evidence of incipient failure or distortion which could cause hazards. Such evidence will differ for each engine type design, and a determination must be made for each case. Although the wording of the current rule is revised, it continues to state that for each type design a proven acceptable condition must be met and demonstrated.

Two commenters recommend that § 33.27(c) (2) (v) and (vi) need not apply if the failure events described are considered improbable. The FAA disagrees. Service experience shows that most severe engine failures, including those caused by disc and shaft failures, would have been judged improbable beforehand. Attempts to apply probability to this rule would not be in the interest of airworthiness.

Two commenters request that maximum permissible r.p.m. be defined as the highest steady state r.p.m. at which an engine shaft can rotate in service. The FAA disagrees. If an engine has a transient rotor speed limitation higher than the steady state limitation, maximum permissible r.p.m. would be the maximum transient speed limit.

Another commenter suggests rearranging § 33.27(c) (2) for clarification and allowing rotor discs with sections thinner than type design to be used to produce equivalent stresses at lower r.p.m. The FAA does not believe that the proposed rearrangement of paragraph (c) (2) would significantly clarify the requirements of the section. While the use of thinned rotor discs as test articles may be justified under certain circumstances, the practice should not be considered typical or normal. The conditions under which this expedient might be acceptable must be evaluated on an individual basis and a determination of equivalency made. Accordingly, the amendment is adopted as proposed.

Proposal 67. This amendment proposes to delete § 33.29(b), which requires that each turbojet engine be provided with a connection for a rotor system unbalance indicator.

A commenter objects to deletion of the requirement for a connection for rotor system unbalance indication. The commenter states that a well-developed system has more than adequate reliability and has capability of giving advance warning of failures which could lead to hazardous events. Two commenters agree to the deletion of the requirement for rotor system unbalance indication. However, one of the commenters adds that airborne vibration monitoring (AVM) could be applicable to some engines and that in cases where reliable AVM systems have been developed, credit could be claimed for the AVM system in showing compliance with various FAR Part 33 (and Part 25) requirements as part of the basic engine type design. Recent experience has demonstrated that in some instances AVM can provide a safety improvement as discussed by the first commenter. Therefore, the requirement is being retained in Part 33 to provide an engine connection for AVM. Retention of the requirement does not impose a significant burden on the engine manufacturer. Accordingly, the proposal to delete § 33.29(b) is withdrawn.

Proposal 68. This amendment adds requirements for fluid injection (other than fuel) system controls under a new § 33.35(e).

A commenter suggests the proposal be changed to read: "the flow of the injected fluid is adequately controlled," and that paragraph (e) (2) be deleted. The commenter explains there exist systems which inject fluid at a fixed rate independent of power lever position. The commenter adds that some systems do not use pumps but utilize engine bleed air for pressurization and control it manually or automatically with power lever or throttle motion. The FAA agrees with the commenter, and the section is revised accordingly.

Proposal 69. This amendment to § 33.43 removes the requirement to comply with established shaft endurance stress limits when operating an engine with one cylinder not firing.

The single commenter concurs with the intent of this proposal but requests that shaft critical speeds for the cylinder-out condition be included in the operating instructions. The FAA considers that testing done under this section will provide safe operating information, including critical speeds, which must appear in the engine operating instructions in accordance with § 33.5. The proposed amendment is adopted without change.

Proposal 70. No comments were received on the proposal to correct a typographical error in § 33.49, and it is adopted without change.

Proposal 71. No unfavorable comment was received on the proposal to amend § 33.63 by deleting the word "normal," which tended to unduly restrict the operating range of rotational speeds when considering vibratory force and stress on engine and structure. The proposal is adopted without change.

Proposal 72. This proposed change to § 33.65 is based on a similar proposal deferred from Notice 75-31 (40 FR 29410; July 11, 1975) and was introduced into the NPRM after the Aircraft Engine Regulatory Review Conference held in January 1978.

The stated objective of this proposed change is to allow flightcrews to completely avoid surge and stall conditions severe enough to cause engine malfunction or damage.

One commenter agrees with the proposal with no amplifying statements. Another commenter, a rotorcraft manufacturer, expects this proposal would supply urgently needed quantitative operating margins. Considering the installation effects of rotorcraft applications, the FAA does not believe this proposal will alleviate the rotorcraft manufacturers' requirements for in-flight investigation of stall and surge characteristics (§§ 27.939 and 29.939).

The combined comments from the other respondents can be summarized as follows:

(1) The objective of the proposed change is commendable; however,

(2) Technology or state-of-the-art does not allow attainment of the objective as stated;

(3) The magnitude of testing, just in terms of variables that would need to be investigated, would be formidable and costly with little or no accompanying increase in safety;

(4) The FAA has not established documentation to justify such a rule change;

(5) An appropriate advisory circular should be issued and coordinated with industry prior to changes to this regulation;

(6) Terms such as "severity of the surge and stall" are ambiguous and unamenable to quantitative testing; and

(7) The current regulation adequately provides the desired information.

At this time, the FAA concurs with the first six items above. It further concurs that item (5) may be the first approach to correcting any FAA disagreement with item (7).

As stated under the "Explanation" of the proposed rule, the current rule is objected to for not being able to define an acceptable or rejectable degree of compliance. After further review, it is concluded that this same objection might apply to the proposed rule. Furthermore, the regulation as proposed will not meet the stated objective. The proposed regulation would still be subject to the interpretive process used to determine compliance during certification. Knowledgeable comments and other information received on this proposal make it doubtful that the objectives can be met at this time.

Considering the above, the FAA is at this time deleting this proposed change.

Proposal 73. This amendment to § 33.66 clarifies standards for bleed air system performance and for indication of the functioning of ice protection systems, if bleed air is used and can be controlled.

There were no dissenting comments. However, one commenter objects to the words "aircraft powerplant" in connection with the ice protection system, as the reader might confuse the engine anti-icing system with the aircraft anti-icing or ice protection system provided for the powerplant. The FAA concurs with the comment to use the word "engine" in place of "aircraft powerplant," and the proposal is modified accordingly.

Proposal 74. This amendment to § 33.67 brings engine fuel system standards into conformity with corresponding sections of the aircraft rules. It also adds new fuel control standards.

Since a large number of comments were received on the various sections of the proposed rule, the following discussion has been subdivided into segments for simplicity of discussion.

Ref § 33.67(a). Although no unfavorable comment was received on the proposal to amend § 33.67 by deleting all but the first sentence of § 33.67(a), the dropping of proposed § 33.67(d) introduces the need to restore, in § 33.67(a), the requirements for proper fuel control system functioning, adjustment, locking, and sealing. Therefore, the proposal is modified by deleting only the last sentence of § 33.67(a).

Ref § 33.67(b). A commenter states the proposed revision should specify that the fuel strainer or filter be installed ahead of the first engine fuel system component which is susceptible to restricted fuel flow due to contaminants. The commenter adds that this would assure that the complete engine fuel system is protected from fuel flow interruption due to contamination.

While there is merit to considering amending § 33.67(b), it goes beyond the scope of the present NPRM. These comments should properly be handled by a future NPRM to allow other interested persons time to submit their views. Therefore, the proposal is adopted without change.

Ref § 33.67(b) (3). No comment was received on the proposal to amend § 33.67(b) (3). Accordingly, the proposal, with respect to § 33.67(b) (3), is adopted without change.

Ref § 33.67(b) (4). A commenter suggested that the last sentence of proposed § 33.67(b) (4) be amended to read: "The applicant must provide evidence. . . ." This is intended to provide experience or alternative means, other than testing, for showing compliance. The FAA agrees that the word "demonstrate" as used in this paragraph would mean to prove by operation of the device, which was not intended as the only acceptable method of substantiation. Therefore, the proposal is modified accordingly.

Ref § 33.67(b) (4) (ii). A commenter suggests deleting proposed § 33.67(b) (4) (ii) and replacing § 33.67(a) with the sentence: "Each fuel system must be capable of sustained operation throughout its flow and pressure range with fuel initially saturated with water at 80°F and having 0.75 cc of free water per gallon added and cooled to the most critical conditions for icing likely to be encountered in operation." The commenter adds that manufacturers should be allowed to show that the total fuel system is capable of operation under those conditions without establishing any specific design criteria such as use of heaters or additives. The commenter further states that some current successful systems use neither anti-icing additives nor fuel heaters.

Another commenter states that although it may be reasonable to accept that a fuel heater can cope with water saturated fuel, the effectiveness of anti-icing additives should be evaluated.

The commenter suggests that the second sentence of § 33.67(b) (4) (ii) be amended to read: "This requirement may be met by showing the effectiveness of specified approved fuel anti-icing additives or that the fuel system is fitted with a fuel heater which is capable of maintaining the fuel temperature at the fuel strainer or fuel inlet above 32°F (0°C) under the most critical conditions."

The FAA does not agree with the first commenter since the proposed change does not restrict the manufacturer to specific design criteria, but rather provides for recognized equivalent means of compliance.

The FAA substantially agrees with the suggestion of the second commenter which rectifies the objections raised and which editorially corrects the proposed changes. Accordingly, the second sentence of proposed § 33.67(b) (4) (ii) is revised except that the words ". . . which is capable of maintaining . . . ." are further changed to ". . . which maintains. . . ."

Ref § 33.67(b) (5). A commenter strongly supports the substance of the proposed revision to § 33.67(b) (5) to require demonstration of filter capability that is related to fuel contamination ". . . likely to be encountered in service. . . ." Another commenter suggests quantifying the degree of contamination to provide a consistent unambiguous requirement which can be applied fairly and consistently. Two commenters suggest the proposal be canceled and the present wording be retained since engine control system malfunctions due to fuel contamination are not a service problem.

Proposed § 33.67(b) (5) is clarifying; however, the rule for engine certification should not relate to ambiguous aircraft flight requirements, but rather to the time of continued satisfactory engine operation in the mode of partial filter blockage.

Also, there is merit to the comment relative to quantifying the degree of contamination; but, further research is required before such limits can be established. Accordingly, proposed § 33.67(b) (5) is revised as discussed.

Ref § 33.67(c). Two commenters suggest the proposal be changed to read: "(1) The flow of the injected fluid is adequately controlled," and one of the two commenters further suggests deletion of (2). The commenters explain there exist systems which inject fluid at a fixed rate independent of power lever position. The second commenter adds that some systems do not use pumps but use engine bleed air for pressurization and control it manually or automatically with power lever or throttle motion. A third commenter suggests that the flow of injected fluid must be controlled in relation to the design requirements of the engine since power produced by an engine can be influenced by a number of factors. The FAA agrees with the commenters and has revised the section accordingly.

Ref § 33.67(d). A commenter suggests that the proposal should provide for consideration of electric/electronic components which have a documented satisfactory service history. Two commenters state that it seems unnecessary to apply the proposed rule to other than full-authority control systems with electrical or electronic input.

Ref § 33.67(d) (1). One commenter suggests deletion of this section of the proposed rule on the basis that definition of reliability level would be subjective. Two commenters state that a comparative reliability level should not be imposed, the first since it was never required of hydromechanical units and the second since a comparable hydromechanical control for a given engine type may not exist. One of the commenters suggests that electronic control system reliability should be based on in-flight shutdown rate. The same commenter questions the meaning of "... combined level."

Another commenter states that adequacy of the secondary systems in controlling the engine for continued flight can only be determined by evaluation on the specific aircraft in conjunction with minimum crew requirements. It is noted that the requirement for continued safe operation of the installed engine after failure or malfunction is addressed in §§ 23.903, 25.903, and 29.903. However, the FAA agrees that the proposed wording is not completely consistent with engine certification requirements.

Another commenter submits a counterproposal which it is claimed will permit control functions not historically available with hydromechanical controls and will allow dispatch of an airplane with one channel of a dual system inoperative.

Another commenter supports the substance of the proposal and suggests the requirement be extended to other components susceptible to external electromagnetic interferences. The FAA agrees that the rule should be so extended; however, since the suggestion is beyond the scope of this review, the commenter is invited to submit it in proposal form for future consideration.

Ref § 33.67(d) (2). Two commenters suggest revising proposed § 33.67(d) (2) to read "Provide a means to monitor the operational status of each function critical for safe engine operation." Another commenter states it is not clear how monitoring the operational status can assure redundancy. The commenter adds that the designer should be permitted to establish compliance in a manner best suited to his particular design.

Ref § 33.67(d) (3). One commenter suggests that the term "independent power source" be clarified to more clearly state the intent. Two commenters suggest the proposal be revised since it is unnecessary to have an independent power source on the engine where a backup hydromechanical control is used in the event of power supply failure.

Ref § 33.67(d) (4). A commenter states that the proposal is too specific and that the engine manufacturer should be permitted to establish the power supply and environmental condition characteristics, including lightning or other electromagnetic interference, in which the control system will satisfactorily operate.

The scope of comments to § 33.67(d) has been extensive and raised several valid points and suggestions. Due to the extent of these comments, it is believed a major modification to this proposed change is required. Therefore, proposed § 33.67(d) is withdrawn. After reevaluation, another NPRM will be published, and the public will be given an opportunity to comment.

Proposal 75. This amendment to § 33.68 revises the requirements which govern performance under icing conditions.

A number of commenters support the proposed exemption of rotorcraft from the ground idling icing requirements, basing their justification on the unique characteristics of rotorcraft and rotorcraft operations. Others who wish to include rotorcraft under this rule point out, for instance, that oil rig operations may include lengthy loading cycles in icing conditions with rotors turning.

One commenter points out that wheel-equipped rotorcraft awaiting departure clearance can be subjected to the same delays as fixed-wing aircraft in foggy weather with temperatures conducive to induction system icing. The FAA agrees that, as a general practice, rotorcraft cannot expect preferential handling or to avoid queuing up at runways. Furthermore, the operation of a helicopter rotor system can itself, within the proposed envelope:

(1) Intensify icing conditions when ground fog or freezing drizzle under stable cloud layers is present; and

(2) Generate freezing ground fog when atmospheric conditions are close to forming natural freezing fog.

Other commenters contend that no rotorcraft have been certificated for intentional flight in icing conditions. The FAA considers this contention somewhat irrelevant in considering ground induction icing conditions. As mentioned above, ground operation can produce induction system icing without the existence of conditions conducive to in-flight icing as defined in Appendix C of Part 25 of the FAR.

Considering the above, and after further review, the FAA sees no justification for excluding rotorcraft from § 33.68(b) and has revised the proposal accordingly.

It also is suggested that a certification time of less than the 30-minute idle specified in the proposed amendment could be applied to rotorcraft engines. This suggestion may have merit, but it is believed that additional operating data are required to support a lower test time. This question will be considered in future rulemaking.

Concerning the envelope to use for testing, one commenter suggests using more general terms to describe the icing envelope, while another suggests adoption of a somewhat more severe military specification.

As was presented during the Aircraft Engine Regulatory Review Conference, recorded meteorological data, from the most severe ground icing experience during civil operation, does not support more stringent criteria. Therefore, the FAA does not agree with the proposal to adopt the military specifications.

In response to the comment to state the requirements in broad terms, the proposed regulation as stated presents minimum atmospheric parameters for all engines to meet. A lack of specific requirements could lead to a generation of engines all meeting different atmospheric conditions. This would not lead to uniformity in the certification process.

One comment was received opposed to allowing periodic engine run-up to shed ice. The comment was based on the possibility of icy taxiways and run-up pads making this procedure risky. The FAA agrees that this comment has merit under certain conditions. However, there are installations where this procedure could be perfectly acceptable under adverse ground conditions. Rotorcraft operation is one such application. The relaxatory nature of this part of the regulation need not be denied applications where safety is not compromised. It should be noted that the manner of this procedure may be controlled by limitations in the engine data sheet and/or operating instructions if appropriate. It is envisioned that run-up power excursions that are excessive or operationally untenable will be disallowed.

Therefore, with the exception of the change to § 33.68(b) discussed earlier, the proposal is adopted without change.

Proposal 76. This amendment to § 33.71 revises the standards for engine lubrication systems and makes them consistent with proposed §§ 23.1019 and 23.1021 and corresponding changes to Parts 25, 27, and 29.

A commenter disagrees with the proposal to delete the requirement for a strainer or filter ahead of each scavenge pump, stating that protecting the scavenge pump is essential to safe operation. The commenter adds that the rule already allows the applicant to size the strainer as needed to protect the pump. The FAA believes that design flexibility should be carried even further and that the need for a scavenge strainer/filter and its sizing should be determined by the engine designer.

Another commenter suggests that § 33.71(b) be further amended to read: "There must be an oil strainer or oil filter, other than at the oil tank outlet, through which all of the engine oil flows." However, this change would not provide additional clarity and would add an unnecessary restriction.

A commenter suggests that § 33.71(c) (5) be amended or deleted to permit marking the word "oil" on adjacent cowlings instead of the engine oil tank oil filler and that the corresponding aircraft rule be amended to conform. Sections 23.1557, 25.1557, 27.1557, and 29.1557 already specify exterior markings as suggested by the commenter. The proposed oil tank filler marking drops the capacity requirement from the current rule but retains the "oil" marking in the interest of safety.

A commenter suggests that proposed § 33.71(c) (12) (ii) call for provision of makeup oil equivalent to that expected to leak from a deteriorated engine. The FAA believes that this requirement is implicit in the proposed rule and would have to be met by airworthy engines under §§ 33.19 and 33.75.

A commenter suggests that proposed § 33.71(f) be deleted because loss of lubrication during "negative g" operation has not been a problem in commercial service. Another commenter suggests deleting the reference to § 25.333 in this section since engines for general aviation fixed-wing and rotary-wing applications do not necessarily comply with it. The commenter further suggests that the amendment require the applicant to define the maximum applied loads as in § 33.23 for mounting attachments. The FAA has no records to indicate the extent of the problem with engine lubrication during negative g operation, and it is correctly noted that a Part 25 requirement should not be imposed on an engine not intended for Part 25 application. The present regulations covering lubrication system design for both reciprocating and turbine engines have been found adequate. The proposed new paragraph (f) is withdrawn as recommended, and the remainder of the proposal is adopted without change.

Proposal 77. This amendment adds a new § 33.74 which defines thrust or power augmentation systems for transport category airplanes.

After further consideration, the FAA has found it to be impractical for an engine manufacturer to comply with § 25.945 as referenced in the new section since this paragraph requires detailed knowledge of the aircraft engine installation, aircraft flight envelope, and power augmentation system hardware supplied by the manufacturer for each aircraft type. This information is seldom available to the engine manufacturer at the time of engine certification. The proposed amendment therefore is withdrawn.

Proposal 78. Two commenters object to the word "hazardous" as proposed for § 33.75, which amplifies and redefines burst limits and corrects a reference to allowable loads in amended § 33.23. They submit that an engine manufacturer is not in a position to judge what is hazardous at the time of engine certification. The commenters recommend using "release of fragments having significant residual energy" as the burst criterion.

The FAA disagrees. Released fragments are important because they may represent a hazard to the aircraft. The hazard may be related to residual energy, but even fragments which have a low residual energy may constitute a hazard. Judgment must be used under either definition by the manufacturer and the FAA during certification to determine what is hazardous. Section 33.75(b), therefore, except for the descriptive parenthetical statement, is adopted as proposed. Reference to § 33.23(b) (2) in proposed paragraph (c) is corrected by substituting § 33.23(a).

Proposal 79. This amendment adds a new § 33.76, which applies the standards of § 25.933, airplane reversing systems, to engine airworthiness.

Two commenters object to the proposed amendment on the grounds that compliance requires an evaluation of the system thrust reverser as a part of a particular aircraft reversing system. The engine manufacturer cannot anticipate or have available the aircraft design and performance data necessary to comply with § 25.933(a) and (b). The FAA agrees, and this proposal is withdrawn.

Proposal 80. This amendment to § 33.77 updates the engine foreign object ingestion requirements. For comments on the amendment to § 33.77(a) (2) and (a) (3), see the proposals for § 33.75(b) and (c), respectively.

A commenter expresses the opinion that ingestion tests should be conducted with simulated engine installation hardware and gearbox loading. The FAA finds merit in these comments but considers the suggested changes beyond the scope of the NPRM. The FAA will review these suggestions for future rulemaking action.

A commenter questions whether an engine running for 5 minutes following the bird ingestion event is adequate. In the absence of an obviously dangerous condition, however, the 5-minute run time is sufficient to demonstrate engine integrity. This commenter also suggests that in addition to the other requirements, any potentially hazardous physical damage following the bird test be considered a failure. The FAA has made this a practice in the past, and the section is changed accordingly.

A commenter submits information from an actual aircraft accident which suggests that bird ingestion certification requirements should be made stricter. The accident cited involved an engine certificated before the current requirements were adopted at a time when less demanding tests were the rule, so that the commenter's remarks may not be currently relevant. The FAA is continually reviewing bird ingestion incident data in terms of possible rulemaking action.

A commenter objects to deletion of the sand and gravel ingestion requirement, stating that the absence of sand/gravel ingestion problems in service is due to the presence of the requirement in the current rule. The commenter points out that in addition to blade erosion, adverse effects on engine seals, bleed ports, and oil sumps may lead to in-flight operating abnormalities. Although it is recognized that sand and gravel ingestion may adversely affect various turbine engine mechanisms, service experience has shown that ingestion of these materials does not possess the potential for causing sudden loss of engine power as does other ingested matter. On this basis, the requirement is withdrawn.

A commenter points out that the specified 4 percent water to air ratio is less than that which may be encountered in the atmosphere and also suggests conducting water ingestion tests at altitude conditions. The FAA agrees that in some severe rain conditions, the water to air ratio exceeds 4 percent but considers that such occurrences represent an environmental extreme rarely encountered in service. Incorporating an increased water-to-air ratio or imposing altitude conditions on the water ingestion requirements are beyond the scope of this review. The FAA will continue to review ingestion test requirements for possible rulemaking action in the future.

Several commenters question the requirement to maintain a 4 percent water-to-air ratio during acceleration and deceleration of the engine. Two of these commenters also question how evaporative effects are to be accounted for in the water-to-air ratio. It is suggested that the wording of § 33.77(c) be changed to "while ingesting water following stabilized operation. . . ." The FAA intends that the 4 percent water-to-air ratio be maintained during transients to simulate actual conditions. It is not expected that this ratio will be maintained exactly but that a minimum of 4 percent water-to-air ratio will be used during transients. The practicality of such testing has been demonstrated.

The goal of water ingestion tests is to simulate flight in heavy rain in which saturation of the air is assumed. If the engine air available during the certification test is not saturated, additional water must be added to ensure a 4 percent liquid water-to-air-ratio at the engine inlet. The proposal for § 33.77(c) is changed to clarify this intent.

A commenter recommends that § 33.77(d) be further amended to require protection from pieces of objects which, although unable to pass through the protective device when whole, may break apart upon striking the protective device and enter the engine. This protection is already provided under proposed § 33.77(d) since it does not exempt from demonstration foreign objects of a size which will pass through the protective device.

Two commenters recommend further amending § 33.77(d) (3) to read ". . . sustained reduction in power or thrust greater than those values required by paragraphs 33.77(b) and (c)." The FAA agrees. The intent is not to require greater thrust recovery for engines with protective devices than for those without them. The proposed rule is changed as recommended.

One commenter disagrees with the wording of § 33.77(e) under ice test quantity. The words "typical inlet cowl" are intended to mean an inlet cowl typical of an installation of the engine being tested. The "slab of ice" is intended to be of a size and weight which provides a test of at least equal severity to the inlet cowl and engine face ice accumulation. The meaning of these phrases is clear, and the proposed wording is adopted.

One commenter objects to the proposed distinction in § 33.77(e) between engines with inlet guide vanes and engines without inlet guide vanes in the 4-pound bird ingestion test conditions. The commenter states that service records do not justify such a distinction and that bird ingestion is an environmental condition not related to fan/inlet design. However, there is reason to distinguish between turbine engines with and without inlet guide vanes in order to test each design under its most critical bird ingestion condition. This does not imply a difference in environment but is believed to provide the best test for each design type. FAA report No. FAA-RD-77-55, "Improved Resistance to Engine Bird Ingestion," dated March 1977, indicates that rotating blade damage is inversely proportional to the entering velocity of the bird due to the addition of the bird velocity vector and the blade velocity vector. An engine with inlet guide vanes is likely to be struck on a vane rather than a blade, and the vane damage will increase with increasing bird velocity. The proposed wording is retained. The FAA will continue to study the bird ingestion hazard.

Proposal 81. This amendment to § 33.83 broadens the vibration test requirements and affords added flexibility to the test methods.

Two commenters suggest that the title be changed in order to better describe the purpose of the test and avoid confusion with §§ 33.33 and 33.63. The FAA disagrees. Section 33.33 is a requirement for the design of reciprocating engines, § 33.63 is a similar requirement for design and construction of turbine aircraft engines, while § 33.83 relates to the block testing of aircraft turbine engines. Section 33.63 is a design consideration for turbine engines, whereas § 33.83 is a substantiation means.

Two commenters object to the use of the term "maximum permissible takeoff speed" since takeoff speed may not be the maximum permissible speed for certain engines. The FAA agrees, and the word "takeoff" is deleted from the first sentence of § 33.83(a).

Three commenters object to the wording of § 33.83(b) concerning acceptable methods for showing compliance. One commenter suggests that stress margins which are appropriate to the components being evaluated be recognized, while the others maintain that compliance can be shown by engine test as well as by analysis. The FAA agrees with both comments but believes the proposed wording is adequate. Each method of showing compliance with this section during the certification process is reviewed by the FAA.

Another commenter suggests insertion of the word "hazardous" before "failure" in § 33.83(a). The commenter points out that there could be minor failures during this test. The FAA considers that all failures should be evaluated in terms of each engine design, as the distinction between minor and hazardous conditions cannot always be pre-established for a new design.

A commenter suggests that some clarification of the term "loading device" would be of assistance. As used in this regulation, the term "loading device" (i.e., dynamometer) applies primarily to turboshaft and turboprop engines. Turbofan and turbojet engines are not usually loaded externally during the endurance test. The intent of this regulation is to assure that the turboshaft and turboprop engines are loaded in the same manner as during the endurance test.

The amendment to § 33.83 is adopted as proposed except for the change described.

Proposal 82. This amendment to § 33.87 clarifies the 150-hour endurance test procedure, provides alternative means of compliance, and adjusts the test schedule for helicopters.

One commenter questions the validity of conducting the endurance test of an accessory drive and mounting attachment on a separate rig, as provided by proposed § 33.87(a) (6). The commenter suggests that rig testing be supplemented by running the accessories on an engine. The FAA has found that when properly conducted, the gearbox rig tests with accessory loading provide sufficient data for endurance certification. In addition, such tests are often a more practical solution to the problem of environmental control and data collection encountered during endurance engine running. The accessory weights and overhung moments must be simulated during full engine testing, but power extraction effects may be substantiated by rig test.

A commenter suggests eliminating operation at rated 2½-minute power during the third and sixth takeoff power periods for one of the twenty-five 1-hour sequences specified by current § 33.87(d) (1). The commenter argues that proposed § 33.87(d) (2) increases the cumulative endurance test time at the 2½-minute power condition and that the increase should be compensated for in § 33.87(d) (1). The FAA does not agree. One reason for including proposed § 33.87(d) (2) is to establish a margin of safety for the 2½-minute power rating. Compensating for the increased time at 2½-minute power would cancel, to some extent, the intent of this proposal. The FAA recognizes that the total time required at 2½-minute power will be increased by 5 minutes but does not consider this increase to be significantly burdensome. However, the wording of proposed § 33.87(d) (2) is revised to make it clear that the 5-minute test at 2½-minute power is to be included within, rather than in addition to, the 30-minute test period.

One commenter requests that an "Emergency Power Rating" (EPR) be established for rotorcraft. The EPR would be a power greater than 2½-minute power and used for one engine inoperative takeoff in multiengine rotorcraft. The EPR would be permitted for up to a 30-second duration. The commenter proposes that the 30-second EPR be included in the 150-hour endurance test in this section. The FAA finds that although this proposal has merit, it is beyond the scope of the Engine Review. Therefore, the amendment to § 33.87 is adopted as proposed except for the changes described.

Proposal 83. This amendment to § 33.88 relieves the overtemperature test requirements by reflecting actual conditions more realistically.

One commenter recommends less reduction in test time than that proposed and suggests that such a reduction be made based on analysis of service experience that shows this to be acceptable. The commenter also recommends that the second sentence be revised to state that the turbine assembly be within dimensional limits established for allowing it to remain in continued service.

The FAA does not agree that the time reduction is drastic since engines certified before Amendment 33-6 were in fact tested for the 5-minute condition. Service experience with these engines, with regard to overtemperature capability is excellent. Additionally, all post-Amendment 33-5 certified engines have been granted exemptions from the existing 30-minute requirement and were tested for 5 minutes as is now proposed. The dimensional limits quoted in the proposal are in fact service limits as suggested by the commenter, which are determined during the certification process. Therefore, the FAA finds further clarification to be redundant.

Another commenter objects that the engine overtemperature test requirements inherently involve blade creep life, which is considered an economic item rather than an airworthiness item. The commenter states that the true need is to evaluate rotor disc integrity under conditions of possible overtemperature due to disc cooling system failure which might result in temperatures higher than the specified 75°F above maximum rated. The FAA position is that the regulation will ensure that the turbine assembly can satisfactorily withstand an overtemperature of 75°F above the maximum operating temperature for a period of time consistent with what could reasonably be expected in service. The test is designed to evaluate gross effects of a 5-minute overtemperature condition on the engine turbine assembly, which includes blades, discs, drums, spacers, shafts, seals, stators, nozzles, and support structure. Therefore, § 33.88 is adopted as proposed.

Proposal 84. This amendment to § 33.89 broadens the operational test requirements by calling for testing, if necessary, throughout the operating envelope of the engine.

A commenter complains that the tests do not demonstrate that rapid throttle movement does not constitute an operational hazard. It should be noted that § 33.89(a), through reference to § 33.73, requires demonstrating rapid throttle movement from minimum to maximum position. This commenter also considers it unreasonable to expect flight crewmembers to monitor engine controls during emergency conditions. The FAA, on the contrary, considers it reasonable to expect pilot monitoring and appropriate manipulation of engine controls within the context of the operational situations addressed by this comment.

One commenter objects that the proposed change has the same meaning as the current regulation while being less explicit. However, the proposed amendment contains all of the previous considerations implicitly within the new wording and at the same time has been expanded to include the entire operating envelope of the engine. Accordingly, the proposed rule is adopted without change.

Proposal 85. This amendment to § 33.90 discontinues use of the word "overhaul" and recognizes the validity of alternative maintenance programs.

One commenter suggests that the rule approve the process of reconditioning after test and inspection if it is determined that such process is required. The FAA agrees that if the test results show that maintenance action is required, it should be so specified. Another commenter suggests that substituting "initial maintenance inspection" for "overhaul test" merely replaces one contentious phrase with another and urges that § 33.90 be deleted as being unnecessary to safety. The FAA does not agree since not all Part 33 turbine engines come under the regimen of a structured reliability program. Recent experience with two new engine certification programs under current rules has shown the need for an initial inspection interval of certain hot section components. Significant deterioration of engine operating and performance characteristics would exist without the specified inspection and repair requirements. Accordingly, the proposed amendment is adopted with the change noted above.

Proposal 86. This amendment to § 33.92 deletes the windmilling test requirement for subsonic turbine engines and amplifies the rotor burst and load limitations as in the proposal for § 33.75(b).

In addition to comments previously discussed for § 33.75, two commenters question deleting the windmilling test requirement for subsonic engines. The commenters suggest that existence of the current requirement may account for the lack of service problems associated with windmilling engines. The FAA disagrees. Most engines currently in service have a certification basis which predates the windmilling test requirement of § 33.92 but, nevertheless, have accumulated years of service with no reported incidents of windmilling hazards. It has not been demonstrated that an engine test of windmilling capability is required for all subsonic engines.

One commenter recommends adding a requirement that the applicant provide evidence to show that the engine windmilling without lubricating oil would not result in a condition which would jeopardize the aircraft. The FAA agrees but believes that § 33.75 provides this assurance. Proposed § 33.92 therefore is adopted with the addition of the reference to mount load limits as proposed for § 33.75.

Proposal 87. No comment was received on the proposal to amend § 33.93(b) by substituting the word "part" for "component" to preclude ambiguity, and the proposal is adopted without change.

Proposal 88. This amendment provides a new § 33.94 which adds blade failure containment testing of engines for certification.

Several commenters object to the requirement of § 33.94(a) that the engine run for at least 15 seconds before initiating shutdown after the event, claiming that it is unduly restrictive. They state that an engine which shuts down in less than 15 seconds would be acceptable, provided it does not burst, catch fire, or generate excessive mount loads. The same commenters propose that § 33.94(a) (1) be changed to permit use of component rig containment tests to supplement the engine test whenever facility limitations prevent attaining maximum permissible speed on a complete engine.

The FAA agrees that certain engines may not be able to operate for 15 seconds after the failure event. Accordingly, § 33.94(a) is modified to allow for instances where the resulting damage prevents the engine running for the required 15 seconds.

The FAA agrees that rig tests are valid, as reflected in proposed § 33.94(b), and in fact manufacturers' rig tests are being used to supplement complete engine blade containment tests for certification purposes. It is concluded, however, that such determinations will be made on a case-by-case basis under the authority provided by proposed § 33.94(b).

Another commenter suggests that § 33.94(a) (2) should be changed so that the engine test is based on the most critical engine casing temperature rather than the most critical turbine blade. Analysis leading to determining the most critically operating turbine blade would be expected to include analysis of case material properties at critical temperatures in an engine operating at maximum permissible r.p.m. Therefore, additional clarification is not considered necessary, and the amendment to paragraph (a) (2) is adopted as proposed.

REGULATORY EVALUATION

The FAA conducted a detailed regulatory evaluation which is included in the regulatory docket. Based on a review of available FAA data, cost data supplied by the Aerospace Industries Association (AIA) and the General Aviation Manufacturers Association (GAMA), and data from the National Transportation Safety Board (NTSB) accident data file, FAA determined that this overall rule provides cost savings that substantially outweigh the additional costs imposed on society.

The amendments in this final rule provide benefits in the aggregate to the aviation public, most specifically to airframe and engine manufacturers. These amendments provide general benefits by deleting obsolete requirements and clarifying the text, by updating and modernizing technical requirements to reflect engineering advances in the state-of-the-art, by reflecting the changing interface between the airframe and engine manufacturers, and by taking into account FAA accumulated service experience. This rule imposes no costs on the Federal Government.

Industry estimates of costs and benefits provided to the FAA for specific amendments were aggregate undiscounted 10-year estimates stated in 1981 dollars. The FAA was unable to break down these aggregate estimates into annual estimates because of the uncertainty of the number of new type certificated engines and aircraft models in a given year as well as the subsequent production of these engines and aircraft in a given year. Furthermore, industry was unwilling to supply information pertaining to the number of companies impacted by each of these amendments, or specific information on the number of estimated new type certificated engines and aircraft in a given year as well as subsequent production estimates, for reasons of individual company confidentiality.

Since it was assumed the Aircraft Engine Regulatory Review initiative would become final rule in 1983, the FAA adjusted the cost estimates to 1983 dollar values and then discounted these values for the years 1984 and 1992 to arrive at a range of values for the 10-year period of 1983–1992. The FAA did this because it was not known in which of these years the costs and benefits associated with the proposals would occur; therefore, by discounting the values in 1984 (assuming all benefits and costs occur in this year would result in the highest possible discounted values) and in 1992 (assuming all benefits and costs occur in this year would result in the lowest possible discounted values), a representative range is developed. The discount rate for 1984 is 0.91 and the discount rate for 1992 is 0.38. This range was conducted for all beneficial or cost imposing proposals except § 23.903(b) where FAA was able to obtain more refined data.

Major Benefits—Regulatory amendments that are expected to yield major benefits are summarized below (first-order discounted cost savings are stated in 1983 dollars and represent the range of savings for the *10-year period* of CY 1983 through CY 1992):

1. Section 23.903—The proposal allows the use of satisfactory foreign object ingestion (FOI) service experience for turbine engines as an alternate to meeting § 33.77 in effect on October 31, 1974, or as subsequently amended, to be eligible for installation. Currently, an airframe manufacturer would have to conduct FOI tests on any inservice turbine engine that is installed on a new airplane even though the engine may have a satisfactory FOI service experience. Estimated discounted test cost savings from eliminating this requirement in terms of 1983 dollars are $2.11 to $5.05 million for the period of CY

1983–1992. Considerable cost could be imposed on airframe manufacturers that choose to install engines certified to Part 33 FOI requirements prior to October 31, 1974, on future type certificated airplanes that have a bad FOI service experience. FAA considers that those instances would be rare from a technological state-of-the-art standpoint.

2. Section 33.14—This proposal provides engine manufacturers with more latitude in the type of procedures they can use for establishing low-cycle fatigue service lives for rotating components and for increasing these lives. This proposal also increases the applicability of the rule, redefines the term "start-stop stress cycle," and permits an alternative to parts temperature stabilization if justified. The current rule is unduly restrictive, because it prescribes only a fixed reduction factor for determining the initial service life and only one method for increasing these lives based on testing of parts removed from service. Estimated discounted test cost savings in terms of 1983 dollars are $16.15 to $38.69 million for the period of CY 1983–1992.

3. Section 33.68—This proposal relaxes the 30-minute idle with freezing fog requirement test criteria, permits periodic engine runups, and permits temperature variation, all with regard to induction system icing. The current test requirement is unnecessarily severe because it is outside the maximum icing envelope of Appendix C of Part 25, and because no tolerances are permitted on the temperature and liquid water content. Program and production cost savings will be achieved through reduced anti-icing system hardware and installation costs and through simplification of the engine design and manufacturing process. Specifically, this amendment eliminates in almost all cases the design and installation of components for a supplementary heating system. Estimated discounted savings in terms of 1983 dollars are $214.02 to $517.17 million for the period of CY 1983–1992.

4. Section 33.71—This amendment deletes the requirement for scavenge oil strainers and marking oil tank filler capacity. Service experience shows that scavenge oil strainers do not necessarily improve safety but do tend to restrict design of the oil system. There is no safety need to mark tank capacity on the oil tank filler. Estimated discounted component, installation, and labor cost savings in terms of 1983 dollars are $2.11 to $5.05 million for the period of CY 1983–1992.

5. Section 33.77—This proposal eliminates the tire, sand, and gravel FOI test requirements. The tire test requirement is deleted because service experience has shown that hazardous consequences from ingestion of a piece of tire are no greater than those associated with ingestion of a 4-pound bird. Furthermore, service experience has shown that ingestion of sand and gravel does not possess the potential for causing sudden loss of engine power as does other ingested matter. Eliminating these requirements will result in some test cost savings and reduced hardware (engine) burnup. Estimated discounted test cost savings in terms of 1983 dollars are $9.62 to $23.02 million for the period of CY 1983–1992.

6. Section 33.83—This proposal allows the use in certain cases of a modified version of the endurance test loading configuration for the required vibration survey which would enable the use of a modified configuration if that loading device is incompatible with the necessary vibration instrumentation. The current regulation is unduly restrictive because it requires that the vibration survey must be conducted using the same configuration of the loading device which is used for the endurance test. A comparable test on the engine will serve the same results. Estimated discounted labor cost savings in terms of 1983 dollars are $4.18 to $10.01 million for the period of CY 1983–1992.

7. Section 33.87—This section allows separate, more convenient rig testing of accessory drives and mounting attachments. The FAA has found that gearbox rig tests with accessory loading provide comparable data to endurance certification tests. The current regulation requires that load testing of accessory drives and mounting attachments must be performed on the engine. The FAA has found this to be too stringent a requirement. There will be possible small cost savings in equipment to operate the accessory drive. Estimated discounted cost savings in terms of 1983 dollars are $1.17 to $2.80 million for the period of CY 1983–1992.

8. Section 33.88—This proposal reduces the duration of the overtemperature test from 30 minutes to 5 minutes. The current rule has been found unnecessarily severe since service experience has shown that none of the turbine engines subjected to 5-minute overtemperature tests have experienced inservice rotor disc primary failure due to overtemperature. Significantly reducing the duration of the overtemperature test adequately demonstrates the integrity of rotor discs without subjecting them to unnecessarily hazardous conditions and saves development of hardware for blades, discs, drums, etc. Estimated discounted test and hardware cost savings in terms of 1983 dollars are $9.03 to $21.62 million for the period of CY 1983–1992.

9. Section 33.92—This amendment deletes the windmilling without oil test for subsonic turbine engines. There have been no reported incidents involving windmilling hazards to aircraft resulting from loss of engine oil, and it has not been demonstrated that an engine test of windmilling capability is required. Estimated discounted test cost savings in terms of 1983 dollars are $0.96 to $2.30 million for the period of CY 1983–1992.

Major Costs—Regulatory amendments that are expected to impose major costs are summarized below (first-order discounted costs are stated in 1983 dollars and represent the range (except § 23.903) of new costs imposed for the *10-year period* of CY 1983 through CY 1992):

1. Section 23.903—This amendment requires that design precautions be incorporated in Part 23 certified airplanes to protect these airplanes from uncontained rotor failure events. As the use of turbine engines on Part 23 certified airplanes increases, especially in for-hire operations, airplanes certified under Part 23 should be afforded the same level of safety from uncontained rotor failures as airplanes certified under Part 25. The FAA obtained information pertaining to two cases in the past 10 years involving uncontained rotor failures in Part 23 certified airplanes. In terms of 1983 dollars, the cost of these accidents (injuries and aircraft damage) is approximately $1.1 million based on values contained in the *Economic Values for Evaluation of FAA Investment and Regulatory Programs*. Assuming that this proposed rule would protect against all uncontained rotor failure events, $0.93 to $2.2 million is the discounted exposure adjusted benefit (cost savings) range for a 10-year period beginning CY 1983. These estimates include the projected increase in the number of hours flown by turbine-powered general aviation airplanes. It is noted in both cases that uncontained rotor failure was the secondary cause of these accidents (incidents), both of which were precipitated by worn components in the gear assemblies according to the NTSB. It is also noted that this rule is proposed in order to prevent a future problem in certain Part 23 airplanes because installation of turbine engines in these airplanes is expected to increase significantly in the next 10 years. Furthermore, a significant increase in the number of Part 23 certified turbine-powered airplanes used in air taxi and corporate operations is expected, and the FAA believes that protection comparable to that required under Part 25 is needed when carriage of passengers is involved.

This requirement places an economic burden on the manufacturers of these small airplanes. This requirement may influence future airframe design in areas such as armor protection and engine location.

In an attempt to derive cost estimates, the FAA contacted GAMA and various airframe manufacturers. Most of these organizations indicated that the proposed regulation would impose significant costs, but they were not able to provide specific estimates because of the complexity of the issues, and the amount of time it would take to compile estimates. Additionally, the extent of specific design changes to future type certificated airplanes was not immediately known.

One industry organization estimates that the cost to the manufacturer of compliance per airplane could easily reach $20,000, including increased engine price, cost of materials, design, development, testing, tooling expense, labor, and normal factory overhead. Specifically, this organization stated that the typical engine would require a containment shield (using a Kevlar fabric which is believed to be the most weight efficient installation) and that design adjustments would be required to provide for proper cooling, assurance of cowling drainage, and access to service points. Furthermore, the organization stated that considerable engineering and flight test development would be involved in assuring that maintenance could be accomplished on the engine, and the development of ballistic confirmation tests and certification would be extensive. The FAA ascertained through discussions with industry that an estimated 10 new turbine-powered airplane models would be eligible to be certified to Part 23 standards during the next decade. Because it is not certain in what years these airplane models will be certified, the FAA assumes that one airplane will be certified each year from 1983 through 1992. Furthermore, the projected production levels for each of these models in future years is not known. Based on past production levels of certain Part 23 turbine-powered airplanes, the FAA assumes an average annual production of 75 airplanes for each newly-certified model in each year following the year of certification.

Using this assumption, 3,375 airplanes will be manufactured between 1983–1992 of models which were newly-certified to Part 23 during this period.

The following table shows that the discounted value of costs over the 10-year period of 1983–1992 in 1983 dollars of requiring design precautions to minimize rotor failure events is $37.8 million. It assumes that the cost of compliance per airplane is $20,000. These are first-order costs which are initially borne by the airframe manufacturer, and the costs do not take into account the effect of increased prices with respect to the impact on domestic sales and foreign competition implications.

Discounted Value of Costs of Proposed Rule

Year	*Airplane Production*	*Cost of Compliance per Airplane*	*Present Worth Discount*	*Discounted Value of Cost of Rule*
1983	0	$20,000	1.00	$ 0
1984	75	20,000	0.91	1,365,000
1985	150	20,000	0.83	2,490,000
1986	225	20,000	0.75	3,375,000
1987	300	20,000	0.68	4,080,000
1988	375	20,000	0.62	4,650,000
1989	450	20,000	0.56	5,040,000
1990	525	20,000	0.51	5,355,000
1991	600	20,000	0.47	5,640,000
1992	675	20,000	0.43	5,805,000
Total	3,375			$37,800,000

This rule would also impose certain second-order costs on purchasers of these airplanes in terms of increased inspection costs (removing and installing the system at each inspection interval) and decreased airplane performance due to a maximum 100-pound increase in airplane empty weight. The benefit/cost considerations may improve because increased use of turbine engines in Part 23 certified airplanes will increase the risk of rotor failure accidents.

2. Section 25.1091—This amendment requires that the FOI criteria of § 33.77 be applied to vulnerable portions of the air induction system such as inlet splitter vanes, duct-mounted instrumentation, and annular rings. Parts of the air induction system such as annular rings and splitter vanes are physically located in front of the engine. These parts were installed to reduce engine inlet noise in a limited number of airplanes. If these components are included, they should be subject to the same FOI requirements as the engine because of their possible breakoff into the engine. Most aircraft induction systems do not use splitters, etc., and therefore most aircraft engines would not be affected by this rule. This requirement was inadvertently left out of Amendment 33-6 in 1974. The estimates of the discounted cost range of improved materials and testing for these specific

Table 1[1]

Aircraft Engine Review Benefit/Cost Matrix By Major Amendment, for the 10-Year Period of CY 1983 Through CY 1992

($ in millions)

FAR		*Benefits*	*Costs*
23	23.903(a) (2)	$2.11-5.05	$-
	23.903(b)	0.93-2.22	37.80
	Subtotal	3.04-7.27	37.80
25	25.1091(e)	-	2.11-5.05
	Subtotal	$ 0	2.11-5.05
27	none	-	-
	Subtotal	$ 0	0
29	none	-	-
	Subtotal	$ 0	0
33	33.14	16.15- 38.69	-
	33.68	214.02- 517.17	-
	33.71(b)	2.11- 5.05	-
	33.77	48.91- 117.11[2]	1.05-2.50
	33.83(a)	4.18- 10.01	-
	33.87(a) (b)	1.17- 2.80	-
	33.88	9.03- 21.62	-
	33.92(c)	0.96- 2.30	-
	Subtotal	$296.53-714.75	$ 1.05- 2.50
	Total	$299.57-722.02	$40.96-45.35

[1] Benefit and cost values are stated in 1983 dollars.

[2] Of this amount, $39.29 million to $94.05 million is the benefit attributed to an accident caused by water ingestion.

items to meet the criteria of § 33.77 in terms of 1983 dollars are $2.11 to $5.05 million for the 10-year period of CY 1983–1992. However, the actual cost of compliance will be much lower because compliance with FOI standards may be shown by analysis as well as testing, and the FAA sees little application of such devices in the future.

3. Section 33.77—This amendment requires that a 4 percent water-to-air ratio be maintained during transients in order to simulate actual flying maneuvers in heavy rain. The current rule requires that the ratio be maintained only for takeoff and idle conditions but does not require any demonstration of the ability to accelerate or decelerate safely under water ingestion conditions. Such ability is essential for safe flight in heavy rains. The FAA obtained information pertaining to one case in the past 10 years involving turbine engine failures due to water ingestion during transients, a Southern Airways accident in 1977. The NTSB reported that the probable cause of the accident was a loss of thrust of both engines while penetrating severe thunderstorms. The NTSB also reported the accident resulted from a loss of thrust caused by ingestion of massive amounts of water and hail which, in combination with thrust lever movement, induced severe stalling in and major damage to the engine compressors.

In terms of 1983 dollars, the cost of this case (injuries and aircraft damage) based on values contained in the *Economic Values for Evaluation of FAA Investment and Regulatory Programs* is approximately $47.0 million. Assuming that this proposed rule would protect against all accidents and incidents involving turbine engine water ingestion, $39.29 to $94.09 million is the discounted exposure adjusted benefit range (cost savings) for the period of CY 1983-1992. This estimate includes the projected increase in the number of hours flown by turbine powered aircraft.

This amendment would require engine manufacturers to conduct a more precise water ingestion test and to collect more test data to verify engine performance as it relates to water ingestion. It could require the engine manufacturer to purchase additional test equipment. The estimated additional discounted cost to the engine manufacturers to perform this test in terms of 1983 dollars is $1.05 to $2.50 million for the period of CY 1983-1992.

The first-order discounted benefit and cost ranges of these major proposals are summarized in Table 1. This table shows that the most conservative benefit/cost ratio for the entire evaluation is $299.57 to $45.35 million or 6.61 to 1.00.

ADOPTION OF AMENDMENT

Accordingly, Parts 23, 25, 27, 29, and 33 of the Federal Aviation Regulations (14 CFR Parts 23, 25, 27, 29, and 33) are amended effective March 26, 1984.

(Section 313(a), 601, and 603, Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421, and 1423); and 49 U.S.C. 106(g) Revised, Pub. L. 97-449, January 12, 1983).

NOTE: The FAA has determined that this amendment yields overall cost benefits by eliminating unnecessarily stringent design requirements and by simplifying and clarifying existing rules without reducing the level of engine installations. The amendment simplifies a number of technical requirements and removes administrative burdens on regulated persons and the FAA through amendment of regulations from which exemptions have been granted. Therefore, it has been determined that this is not a major regulation under Executive Order 12291. In addition, the FAA has determined that this amendment is not significant under the Department of Transportation Regulatory Policies and Procedures (44 FR 11034; February 26, 1979). The evaluation prepared for this action is contained in the regulatory docket. A copy of it may be obtained by contacting the person identified under the caption "FOR FURTHER INFORMATION CONTACT."

Amendment 27-21

Rotorcraft Regulatory Review Program: Amendment No. 2

Adopted: August 14, 1984 Effective: December 6, 1984

(Published in 49 FR 44422, November 6, 1984)

SUMMARY: This rule adopts new airworthiness standards for type certification of normal and transport category rotorcraft. New standards are necessary because of the phenomenal growth of the rotorcraft industry and the recognition by both government and industry that the updated standards are needed. This rule changes those sections of Parts 1, 27, 29, and 91, of the Federal Aviation Regulations which apply to rotorcraft flight characteristics, systems, and equipment.

FOR FURTHER INFORMATION CONTACT: Jim S. Honaker, Regulations Program Management (ASW-111), Aircraft Certification Division, mailing address: P.O. Box 1689, Fort Worth, Texas 76101, or office location at 4400 Blue Mound Road, Fort Worth, Texas 76106, telephone (817) 877-2552.

SUPPLEMENTARY INFORMATION: These amendments are the second in a series of amendments to be issued as a part of the Rotorcraft Regulatory Review Program. The first of the series of amendments of the Rotorcraft Regulatory Review Program addressed applicability, instrument flight rules (IFR) certification and icing certification standards and was published in the *Federal Register* on January 31, 1983 (48 FR 4374).

These amendments are based on Notice of Proposed Rulemaking No. 82-12 published in the *Federal Register* on August 26, 1982 (47 FR 37806). All interested persons have been given an opportunity to participate in the making of these amendments and due consideration has been given to all matters presented. A number of substantive changes and changes of an editorial and clarifying nature have been made to the proposed rules based upon relevant comments received and upon further review by the FAA. Except for minor editorial and clarifying changes and the substantive changes discussed below, these amendments and reasons for their adoption are the same as those contained in Notice 82-12, and, unless otherwise indicated, the proposals contained in the Notice have been adopted without change.

DISCUSSION OF COMMENTS

The following discussions are keyed to like-numbered proposals in Notice 82-12 and are presented in the same order as the corresponding amendments found in the rules portion of this document.

Proposal 2-1. Three comments were received to this proposal, all of which primarily agreed but raised areas of concern. One commenter recommends deleting the last sentence of the § 1.1 proposed definitions of climbout speed and takeoff safety speed. That sentence, in both definitions, states that these airspeeds are determined from the Rotorcraft Flight Manual. The commenter is correct in that this location of airspeed information is not appropriate in a definition. The location of airspeed information is also inappropriate for a certification applicant that determines these airspeeds by engineering actions which are used to develop the Rotorcraft Flight Manual. Accordingly, the last sentences in these proposed definitions are deleted.

The same commenter and a second commenter suggest that further changes appear necessary to clarify and differentiate between the definitions and abbreviations in Part 1 pertaining to fixed-wing aircraft and helicopters. Such a change, however, was recognized by the commenters as being beyond the scope of the Notice.

A third commenter suggests that, as worded, takeoff safety speed will be applicable to fixed-wing aircraft and a decision on its inclusion should be withheld until fixed-wing operators have commented. All three commenters have some association with fixed-wing aircraft and offered no comments on conflict with aircraft usage. The FAA concludes that the definition is compatible with all aircraft. The definitions of this proposal are adopted with the changes noted.

Proposal 2-2. No comments were received on the proposal to add the definition of V_{TOSS} to § 1.2 except the recommendation for further clarification between rotorcraft and airplane definitions and abbreviations of Part 1 noted in Proposal 2-1. The proposed amendment is adopted without change.

Proposal 2-3. No comments were received on this proposal.

Proposal 2-4. One commenter recommends deleting the phrase "prior to takeoff" from the proposed addition of § 27.45(f) concerning engine power determination. A second commenter made the same recommendation for Proposal 2-33.

Determining engine power available before being committed to flight has long been a problem that helicopter pilots have faced. During normal operations, applying full power results in the helicopter becoming airborne and climbing. Even applying full power to only one engine on a multiengine helicopter will result in it becoming light on the landing gear, essentially flying, or actually airborne if operating at a light weight. Shortly after becoming airborne is not the proper time for the pilot to discover that there is less power available than anticipated.

The first commenter states that the proposed change does not recognize advances in technology which may indicate engine condition to the pilot before takeoff and that a power check before each flight is time-consuming, unnecessary, and economically punishing. The second commenter states that engine characteristics are such that meaningful checks must be completed at or near such [full power] ratings which would probably result in single-engine liftoff.

As noted in the explanation of Proposal 2-33, a preflight power-assurance check procedure is required by special conditions for all current transport category turbine-powered rotorcraft. Compliance typically involves flight manual instructions for partial power checks in addition to specifications for validating limit power during production acceptance and engine maintenance or replacement activities. Similar methods of compliance are suitable under the proposed rule. The FAA recognizes the deficiencies of such a pretakeoff check as stated by the second commenter but considers this procedure significantly safer than having no means to evaluate engine operation.

The second commenter suggests that a system of engine condition monitoring carried out at significantly high power plus a preflight function check would satisfy this requirement. The FAA agrees provided the commenter's meaning of "preflight functional check" is essentially the same as "a means must be provided to permit the pilot to determine prior to takeoff." The proposal does not preclude the use of advanced technology for a system such as automatic monitoring of engine condition with appropriate warnings to the pilot.

A third commenter states that there is a need to simplify procedures and recommends use of a calculator, either mechanical or electronic, as an improvement over charts. Specifying such a means to make a power check would inhibit innovation. The proposed amendment is adopted without change.

Proposal 2-5. The only comment received agrees with the proposal.

Proposal 2-6. One commenter agrees with the proposal to change § 27.79 to permit determination of the height-velocity envelope at the highest weight allowing hovering out-of-ground effect. A second commenter recommends that the second sentence of the proposal be changed for helicopters such that the weight need not exceed the highest weight allowing hovering out-of-ground effect at altitudes above sea level. This commenter states that his proposed change would be in agreement with the change proposed (and subsequently accepted) for § 29.79 in Notice 80-25 (45 FR 83424), the first Notice of this Rotorcraft Regulatory Review Program. However, that Notice states that the height-velocity demonstration weight must be the maximum approved for takeoff and landing but need not exceed the weight allowing hovering out-of-ground effect. The new § 29.79(a)(2) establishes demonstration weights at or near the maximum operating weight. The commenter's suggestion does not establish a minimum demonstration weight, that is, minimum weight does not exceed the highest weight allowing hovering out-of-ground effect. Accordingly, the amendment is adopted without change.

Proposal 2-7. One commenter agrees with the proposal to simplify § 27.141 and add temperature accountability into the flight characteristics requirements. A second commenter questions the need to demonstrate all flight characteristics at all allowable temperatures and requests that the basis for the need be clearly addressed in Advisory Circular 29-2, "Certification of Transport Category Rotorcraft," and in the comparable document that is to be written for Part 27. This information will be included in the advisory circulars. The FAA has found that some advanced technology rotor systems are affected by temperature variations in some areas of stability and control, vibration, and the more well-known rotor blade tip mach number effects. The amendment is adopted as proposed.

Proposal 2-8. Only one comment was received, and that comment agrees with the proposal.

Proposal 2-9. Only one comment was received, and that comment agrees with the proposal.

Proposal 2-10. One comment on the proposed § 27.161 trim control requirements recommends that the control forces must be trimmable only to "approximately zero" rather than "zero." The proposal did not address control force but only adds collective trim control to the present requirement for longitudinal and lateral trim controls. The commenter states that for many years helicopters have operated successfully without "zero" trimming and that the small deviations from zero have been taken care of by small amounts of friction.

The commenter's suggestion is the same as one received for the Rotorcraft Regulatory Review conference (conference Proposal 35) and was discussed in the Appendix to Notice 82-12. The FAA finds that the reasons given in the Appendix to Notice 82-12 for requiring zero trim are still valid.

A second commenter agrees with the proposal, but wants the capability of disabling the trim system at the pilot's option for takeoff, landing, and hovering. This change is beyond the scope of the Notice. The amendment is adopted as proposed.

Proposals 2-11 and 2-12. One commenter recommends deleting proposed paragraphs 27.173(c) and 27.175(d), both of which refer to static longitudinal stability in a hover. The commenter states that hovering is a hands-on flight condition requiring continuous movement of all four controls. The commenter argued that requiring that the pilot's hand be in a certain range of positions does not result in an increased level of safety. The commenter also states that the general paragraph on controllability and maneuverability provides adequate safety requirements.

The proposed changes concerning the hover flight regime serve only to clarify the present rules. Existing stability and control literature shows the unsafe flight conditions resulting from excessive negative stability and the limits of negative stability that allow controlled, but not necessarily acceptable, flight. The FAA agrees that hovering presents special considerations. Deleting the paragraphs, as the commenter suggests, would leave the hover flight condition addressed by the most general of requirements. This could lead to a confusion of interpretations of hover requirements such as including requirements intended only for level forward flight. To meet the positive stability requirements of forward flight during hover would be extremely burdensome, perhaps not even possible.

A second commenter agrees with both proposals as written. These amendments are adopted as proposed.

Proposal 2-13. One commenter agrees with the proposal to add a new § 27.177 requiring positive static directional stability. A second commenter recommends deleting the last sentence, which requires sufficient pilot cues of sideslip to assure safe operations, because it is unnecessary and introduces a qualitative issue which could lead to misinterpretation and misapplication of the intended rule.

While the FAA does not agree that the last sentence should be deleted, it has been changed to read "Sufficient cues must accompany sideslip to alert the pilot when approaching sideslip limits." This will more clearly state the intent of the rule. The alternative to this somewhat broad statement would be to identify all possible cues which would result in unnecessary complexity.

A third commenter recommends that instead of requiring positive static directional stability, the rule should only require that there be no negative static directional stability perceptible to the pilot through the directional pedals. Positive directional stability is necessary to ensure minimum satisfactory stability and control characteristics and to inhibit exceeding sideslip limits. This suggestion could result in considerable misinterpretation and misapplication as to how much negative stability is perceptible to which pilot.

The third commenter also states that the proposed requirement to demonstrate static directional stability will increase certification test time by 5 hours. Review bv the FAA indicates that the wording of the proposal, with reference to the conditions for demonstration of static longitudinal stability, could be misinterpreted to require excessive (5 hours) testing. The amendment is reworded to specify testing at the trim airspeeds used to demonstrate static longitudinal stability in climb and level flight (and in autorotation for Part 29) tests. This will permit the directional stability tests to be accomplished on the same flights as static longitudinal stability tests with an increase of test time of less than 1 hour.

The amendment is adopted with the noted changes to clarify the intent of the proposal.

Proposal 2-14. One commenter agrees with the proposal to add a new § 27.610 specifying lightning protection requirements. A second commenter suggests limiting the lightning protection requirement to those rotorcraft being certificated for IFR flight. This commenter states that in 13 million VFR flight hours of one manufacturer's fleet, only one non-severe lightning strike was reported and that a statement in the Rotorcraft Flight Manual to avoid flying near storms or vertical clouds would be sufficient. This commenter also states that meeting the requirement would be very expensive and complex but he fails to provide any details or other indication of cost or magnitude. Research by numerous technical groups studying lightning has disclosed that strikes occur in both VFR and IFR conditions. These studies have also shown that unless thunderstorm turbulence, hail, and rain are circumnavigated by well over 25 miles, an occasional lightning strike will occur. There are many reports of lightning strikes occurring to aircraft operating between clouds or in areas where no thunderstorms were forecast, and a few pilots have reported "bolts from the blue."

The FAA is aware of one U.S. manufactured helicopter series that has been struck by lightning four times since certification in 1980. This particular helicopter series is very limited in number, but most operations have been in a more than normally hostile weather environment. Only minor damage resulted from the lightning strikes because the helicopter manufacturer voluntarily followed good design practices for lightning protection although the applicable airworthiness regulation had no specific lightning protection requirement. In a recent study including in-flight strike data collected over an eight year period, 36 percent of the recorded strikes occurred below 10,000 feet mean sea level (MSL) altitude, and 87 percent of the recorded strikes occurred below 16,000 feet MSL. Since rotorcraft are not pressurized, are rarely equipped with oxygen, and operation at the higher altitudes is inefficient, most operations occur below 10,000 feet MSL and very rarely above 16,000 feet MSL.

The proposed change uses the same words as those used for large airplanes in Part 25. Many airplanes have been struck by lightning, but only a very few have resulted in catastrophic failure. Since the wording of the proposed change is general in nature and there are no specific provisions uniquely applicable to fixed-wing aircraft, the FAA concludes extension of the standard to rotorcraft will provide rotorcraft occupants the same degree of safety from lightning as provided fixed-wing aircraft occupants.

The FAA forecasts that by the year 2000 the rotorcraft fleet size will nearly double to approximately 20,000 units. In addition, the trend is going towards more complex, fully instrument flight equipped rotorcraft that will be conducting more operations in adverse weather conditions, including icing, where lightning strikes are more likely to occur.

Application of new technology to rotorcraft is also a factor in consideration of the need for protection against lightning. There is an increasing trend toward the use of composite materials in the rotorcraft structure. Since these materials are nonconductive, additional precautions must be taken to assure proper lightning current paths to retain structural integrity and allow protection of installed systems. Programmable, microprocessor-based digital equipment is rapidly being applied in critical functions such as electronic fuel controls and Electronic Flight Instrument Systems (EFIS). The EFIS systems have complete instrument panel displays that are of the cathode ray type, driven by digital computers. Many present generation automatic flight control systems are digital based, and further application of digital computer technology to critical flight controls is anticipated. If proper design precautions are not taken in the basic rotorcraft and system installations, computer memories can be lost, programs can be upset, or complete computer destruction can occur with a lightning strike.

Although Notice 82-12 presented no economic estimate for this change and specifically requested such data, none was received—except the second commenter's statement that it would be "very expensive." However, as noted in Table 1 of the economic summary, an FAA, NASA, and DOD task force is engaged in a lightning research effort. The FAA plans to pass the results of that effort on to the public via advisory circular material, thus minimizing each applicant's lightning research costs.

In view of the increased criticality of structure and systems subject to lightning damage, plus the increase in fleet size and operations in environments where lightning strikes frequently occur, the FAA finds it necessary to provide these standards. Therefore the amendment is adopted as proposed.

Proposal 2-15. One commenter suggests that "any failure" as used in proposed § 27.672(a) be clarified to exclude mechanical failures. The FAA disagrees as §§ 27.695(c) and 29.695(c) require that for power-boost and power-operated control systems, "The failure of mechanical parts (such as piston rods and links), and the jamming of the power cylinders, must be considered unless they are extremely improbable."

FAA review noted that the reference to § 29.671 should be § 27.671; this is corrected. The proposed amendment is adopted with the corrected reference.

Proposal 2-16. Only one comment was received, and it agrees with this proposal.

Proposals 2-17. One commenter agrees with the proposal to add a new § 27.729 concerning landing gear retracting mechanisms but states that with existing systems where "landing-gear-not-down-warning" is based only on airspeed, there is a problem of continuous warning when operating with Category B external loads at slow airspeeds and with the landing gear retracted. The proposal requires a manual shutoff capability which will enable the crew to silence the aural warning and continue such external-load Category B operations. Several rotorcraft have an airspeed activated system and the FAA has found that this is satisfactory. The amendment is adopted as proposed.

Proposal 2-18. Only one comment was received and it agrees with this proposal.

Proposal 2-19. This is a parallel proposal to Proposal 2-52. See that proposal for comments, analysis, and changes.

Proposal 2-20. This proposal changes the title of § 27.785 and significantly increases the detail of seats, berths, safety belts, and harnesses requirements. One commenter suggests that paragraph (b) be replaced by a requirement that each occupant must be protected from head and upper torso injury by a safety belt and shoulder harness. This commenter states that the shoulder harness increases an occupant's tolerance to vertical impact loads without injury from about 4g to 25g. However, no cost data for this requirement were submitted and the FAA estimates that the cost would be significant. The FAA is participating in several studies and reviews of crash results and requirements.

The proposed amendment aligns the rule with airplane rules and the limited conclusions available to date. It would be inappropriate to accept the suggested change until more data, especially cost, are available from these or other studies.

A second commenter suggests that a third option be listed in paragraph (b)(2) indicating that a safety belt plus a shoulder harness is acceptable and that the proposed (b)(2)(ii) be prefaced by the phrase, "for aft-facing seats."

The latter portion of this suggestion would appear to eliminate consideration for side-facing seats, while the proposal, without the "aft-facing seat" phrase, was intended to include seats with any orientation.

The first portion of this commenter's suggestion points out that a combination of safety belt and shoulder harness is an acceptable method. This proposed change helps clarify the amendment and is included in paragraph (b)(2).

A third commenter notes that the National Transportation Safety Board (NTSB) has recommended for many years that shoulder harnesses be installed in light airplanes at all seat locations and sees no difference in the basic survivability issues between airplanes and rotorcraft. This commenter concludes that sufficient data, including U.S. Army crashworthiness data dating back to 1960, are available to justify a requirement for a shoulder harness at each seat location in normal category rotorcraft. A fourth commenter states that every effort should be made to take advantage of the research and development conducted during the last several years to require built-in crashworthiness. As noted, most of the crashworthiness studies have been accomplished by and for the military, which has different design standards than civil rotorcraft. Using only military data to establish civil requirements could very well result in requirements that would be excessively and possibly prohibitively expensive in initial and operating costs. Further changes will be deferred until completion of the FAA crashworthiness program. The amendment is adopted with the one change discussed.

Proposal 2-21. Only one comment was received. It agrees with this proposal.

Proposal 2-22. One commenter agrees with the proposal to relax equipment, systems, and installation design requirements for single engine rotorcraft and to require consideration of lightning strikes on rotorcraft.

Two additional commenters suggest that proposed § 27.1309(d) include a reference to § 27.610, to agree with the § 29.1309. This reference is added.

A fourth commenter says he does not understand the different criteria based on the number of engines. In the present rules, the requirements in § 27.1309(a) and (b) are identical to § 29.1309(a) and (b), which is contrary to the concept of less strict requirements in Part 27, where applicable. The proposed change relieves the requirements of Part 27 by considering only probable failures and by recognizing the different operational capabilities and levels of probable safety between single-engine and multiengine rotorcraft after a probable failure. The proposed amendment is adopted with the reference to § 27.610 added.

Proposal 2-23. This proposal adds a new § 27.1329 describing automatic pilot system requirements. One comment suggests that "system" be replaced with "automatic pilot" to be consistent with § 29.1329(e). This will also be consistent with §§ 23.1329(e) and 25.1329(g). The FAA concurs and the proposal is adopted with this change.

Proposal 2-24. Only one comment was received and that comment agrees with this proposal.

Proposal 2-25. Only one comment was received and that comment agrees with the proposal.

Proposal 2-26. One commenter recommends adding the phrase "except for the weight demonstrated according to § 27.79" to indicate more clearly that height-velocity data are in no way limiting to the proposed change to delete § 27.1519(b) and the (a) designation of § 27.1519(a).

The explanation in the Notice gives considerable detail about changes being made to the rule to clarify that height-velocity data are not limitations. Also similar wording has been in effect for many years without causing problems. Therefore, the commenter's exception phrase is not considered necessary. A second commenter agrees with the proposal. The amendment is adopted as proposed.

Proposal 2-27. Only one comment was received and it agrees with this proposal.

Proposal 2-28. One commenter agrees with the proposal concerning § 27.1555, Control Markings. A second commenter suggests that proposed paragraph (e), which would require that the maximum landing gear operating speed be plainly marked close to the landing gear control, be deleted as unnecessary. This commenter states that all pilots know landing gear operating speeds without spoonfeeding them with unwarranted placards and instructions. The FAA does not agree.

Retractable landing gear is still not common in small helicopters. A pilot that flies rotorcraft with and without retractable gear may know and review the operating speeds but landing gear speeds are not speeds that stand out during a review. Therefore, a placard reminder seems prudent.

The FAA has reviewed the proposal to require the marking to be located close to the landing gear control. While displaying the speed near the control has several advantages, many pilots prefer using one placard for several airspeed limits. A one-placard concept allows placing this information where it is consolidated and clearly available to the pilot without disrupting good instrument or control placement. Therefore, this proposal, as adopted, requires the maximum landing gear operating speed to be displayed in clear view of the pilot to permit the one-placard concept.

Proposals 2-29. One commenter agrees with the proposal to shorten the limitation placard wording required by § 27.1559. A second commenter suggests that the required placard state, "Refer to the approved Rotorcraft Flight Manual for kinds of approved operations." According to the commenter, this would relieve the requirement for a drawing change, a new decal, and FAA approval of these each time there is a change in approved operations.

Normally, this would be a very minor part of the effort to obtain FAA approval of a different kind of operation. One manufacturer sends Rotorcraft Flight Manual Supplements to all owners when a modification kit is FAA approved; however, each rotorcraft is not approved for the new kind of operation until the kit is installed, so a pilot looking at one of these Rotorcraft Flight Manuals still would not know if the helicopter is approved for that type operation. The limitation placard as proposed is the most positive method of readily identifying the kinds of operations that are approved for a specific rotorcraft. The amendment is adopted as proposed.

Proposal 2-30. One commenter agrees with the proposal. A second commenter recommends that the proposed § 27.1585(a) (1) and (2) and the lead-in sentence to these subdivisions be deleted. This commenter states that the phrase "other information" in paragraph (a), concerning operating procedures, adequately covers the requirement to identify takeoff and landing surfaces used in the tests and the appropriate airspeeds. The commenter states that the requirement to identify takeoff and landing surface and associated airspeeds is not the only type of "other information" and should be contained in guidance information rather than the rule. While the kind of takeoff and landing surface and associated airspeeds are not the only type of "other information," these are important and specific enough to be included in the rule as a requirement for all rotorcraft. The amendment is adopted as proposed.

Proposal 2-31. One commenter agrees with the proposal. A second commenter suggests statements in § 27.1587 to prevent including performance information which exceeds operating limits and a requirement to show the maximum demonstrated wind for starting and stopping the rotors. This commenter also suggests that the minimum demonstration wind for starting and stopping the rotors be at least 17 knots to agree with controllability and maneuverability requirements. These suggestions were originally conference Proposal 144 and were removed from further consideration as noted in the Appendix of Notice 82-12 as being an unnecessary burden for small rotorcraft. The rationale in the Appendix explanation is still valid. The amendment is adopted as proposed.

Proposal 2-32. No comments were received on this proposal.

Proposal 2-33. Two commenters suggest that the word "limiting" be deleted from the proposed § 29.45(c) (2) as it related to power absorbed by the accessories and services. The second of these commenters recommends that "and approved" be added to the end of this proposal. Both commenters state that including the word "limiting" will cause confusion since the intent of the change is to allow power determination with the accessories at a value less than the limit value. As an example, an applicant may select a generator that has a "limit" rating of 300 amperes but the maximum load possible for this specific rotorcraft would be 200 amperes; therefore, the power absorbed by this generator load would be based on 200 rather than 300 amperes. Adding equipment to this rotorcraft that could impose a load greater than the 200 amperes would require meeting all the certification requirements, including power determination, as if a larger generator were installed. Both commenters suggest that guidance material should be used to clarify power determination. The FAA agrees with these comments and § 29.45(c) (2) is changed by deleting "limiting" and adding "and approved".

The same two commenters also recommend that the phrase "prior to takeoff" be deleted in the proposed § 29.45(f). A third commenter suggests simplifying the procedure with a mechanical or electronic computer. The FAA's response to these comments is contained in the discussion of Proposal 2-4. This portion of the amendment is adopted as proposed.

Proposal 2-34. One commenter agrees with the proposal. A second commenter notes that as the proposal is worded, a critical decision point (CDP) and acceleration to V_{TOSS} below 35 feet or a descent from the CDP to below 35 feet while accelerating to V_{TOSS} would not be permitted. This is not the intent of the proposal. This commenter suggests the wording ". . . takeoff safety speed and a height of 35 feet above the ground or greater and the climbout must be made . . . ." This wording corrects the proposal to that intended and § 29.59 is revised accordingly.

Proposals 2-35 and 2-36. Only one commenter responded to these proposals, and his comments agree with both proposals.

Proposal 2-37. The comments offered on Proposal 2-7 were also provided on the proposal to add temperature considerations to § 29.141. See explanation for Proposal 2-7. The amendment is adopted as proposed.

Proposal 2-38. Only one comment was received, and it agrees with this proposal.

Proposal 2-39. Only one comment was received and it agrees with the proposal.

Proposal 2-40. One commenter suggests that a directional trim requirement be added to § 29.161. As stated in Proposal 2-10 explanation, directional trim was considered and deemed not required. The commenter does not present justification that had not been previously considered. The commenter also suggests requiring trimming of collective forces to zero in a hover. This was also considered and, as noted in Notice 82-12 (Proposal 2-10), hovering flight is considered a hands-on condition for which a trim requirement is not warranted.

The same commenter further suggests that cyclic and directional control forces of zero in a hover are not required, but some maximum value, such as 5 pounds, should be required for each axis. This is beyond the scope of the Notice.

A second commenter suggests requiring the capability to disarm the trim system. This also is beyond the scope of the Notice. The amendment is adopted as proposed.

Proposals 2-41 and 2-42. Both of these proposals concern static longitudinal stability in a hover as addressed in § 29.173 and § 29.175. One commenter agrees with both. A second commenter had the same comments as for Proposals 2-11 and 2-12, proposals for comparable requirements for Part 27. Refer to Proposals 2-11 and 2-12 for explanation. In Proposal 2-41, reference to § 27.175(a) and (d) is corrected to § 29.175(a) and (d). The amendment is adopted with the noted corrections.

Proposal 2-43. The same comments as for Proposal 2-13 were received for this proposal adding static directional stability requirements in a new § 29.177. See Proposal 2-13 for explanation; the same changes are made and the amendment adopted.

Proposal 2-44. One commenter agrees with the proposal for a new § 29.181 concerning dynamic stability for Category A rotorcraft. A second commenter suggests deleting the entire proposal because the FAA's claims are incorrect when stating that all recently certificated models have met this dynamic stability requirement and that it is less stringent than the fixed-wing requirement. This commenter states that some recently certificated rotorcraft may possess positive damping but most do not comply throughout the approved operating envelope. To meet this requirement, according to this commenter, some degree of added stability augmentation would be required at a significant increase in cost and complexity.

The proposal explanation includes considerable detail as to why this dynamic stability requirement is for Category A rotorcraft only, how it relates to the Category A concept, and how it is necessary as a backup standard for the Category A IFR stability augmentation failure condition. Recently certificated Category A rotorcraft have met this standard at airspeeds above climb speed which is the proposed requirement. All recently certificated Category A rotorcraft may not have met this standard throughout their approved operating envelope as this commenter incorrectly implies the requirement to be.

In comparing the proposed dynamic stability requirements with those of fixed-wing airplanes, this second commenter states that following a stability augmentation failure, § 25.672 requires an airplane to meet only the controllability and maneuverability standards, not the stability or other flight characteristics standards, while the proposed IFR requirements for Part 29 (Notice 80-25 [45 FR 83424; December 18, 1980], which have been adopted without change in this area) include the requirement to meet all the flight characteristics of Subpart B of Part 29. This difference in the requirements between Part 25 and Part 29 results in airplanes not being required to comply with the dynamic stability standards after a stability augmentation system failure, while including this proposal in the Subpart B of Part 29 will require the Category A rotorcraft to continue to meet the standard after a failure when seeking IFR certification. The commenter is correct in that for the IFR failure case, not only is the specific standard for dynamic stability more strict but flight characteristics standards, in general, are more strict. Justifications for the Part 29 IFR requirements are contained in Notice 80-25 and in the preamble of the final rule (48 FR 4374; January 31, 1983). However, Notice 82-12 proposes a new § 29.672 which reads essentially the same as § 25.672; so for the Part 29 VFR case, a stability augmentation system failure does not increase the standard compared to Part 25. For VFR certification under Part 29, the proposed requirement for only positive damping is less stringent than the heavily damped requirement in Part 25. Accordingly, the amendment is adopted as proposed.

Proposal 2-45. This proposal establishes lightning protection requirements in a new § 29.610. See Proposal 2-14 for comments and explanation. The amendment is adopted as proposed.

Proposal 2-46. One commenter agrees with the proposal to add a new § 29.671(c), stating that it "could add appreciably to the cost of manufacture and maintenance; however, . . . the cost may be justified." This commenter also notes that future "fly-by-wire" helicopters will require ground testing such as proposed.

A second commenter suggests the proposal be deleted stating that it would not fulfill the objectives desired by the FAA, that control interference and rigging checks cannot be conducted on the flight line, and that the quality of maintenance is not relevant to airworthiness regulatory action. It is likely that only significant control interference or misrigging would be discovered on a preflight check and these should have been detected on maintenance inspections; however, foreign objects in the control system and some partial failures could be detected. The quality of maintenance may not be relevant to type certification, but affording the pilot the capability to assure (within limits) that the aircraft is airworthy certainly is relevant. The recent trend towards use of composite rotor hubs with fewer hinges further restricts the allowable control inputs that can be made with the rotors turning and the rotorcraft on the ground. Therefore, unless some other alternative is provided, the pilot will have even less capability to determine airworthiness.

The second commenter further reviews the 13 accidents cited in the Notice where it was stated that three might have been prevented by a method to check full control action before takeoff. This commenter states that none of these accidents would have been prevented by the proposal. This commenter cites one accident that occurred 3 to 4 miles from the departure point, and concludes that the proposed preflight check would not have been of merit. The same conclusion is reached in three other accidents where there was some period of flight before an accident. The FAA does not concur that a period of flight before an accident occurs proves that the proposed check is invalid. The critical control condition may not have been encountered until that point in the flight. It also should be noted that the six types of helicopters involved in these accidents were certificated in 1952, 1956, 1961, 1968, 1970, and 1976. This commenter concludes with the statement, "Thus, it appears that from Part 29 helicopter accident history, there is no justification to incorporate this NPRM." As explained in the Notice, a few accidents "might" have been prevented. The available data are not sufficient for a positive conclusion either way. But there has been a sufficient number of control system failures and incidents to clearly indicate a problem area. In view of the catastrophic effects of a failure and the increasing complexity of control systems, improved preflight check capability is appropriate. Accordingly, the amendment is adopted as proposed.

Proposal 2-47. This is a parallel proposal to that contained in 2-15. See that proposal for explanation and analysis. A second commenter noted the typographical error that refers to § 29.67 which should be § 29.671; this is corrected and the amendment is adopted.

Proposal 2-48. Only one comment was received, and it agreed with the proposal.

Proposal 2-49. One commenter agrees with the proposal to revise § 29.729(f) and add a new § 29.729(g), but references his comment on Proposal 2-17. See the explanation for that proposal. The amendment is adopted as proposed.

Proposal 2-50. Only one comment was received, and it agrees with the proposal.

Proposal 2-51. One commenter agrees with the proposed change to § 29.771(b) to require consistency between pilot stations and states that the requirement should apply to Part 27 as well. This is beyond the scope of the Notice. The amendment is adopted as proposed.

Proposal 2-52. One commenter agrees with the proposal to add a new § 29.779. A second commenter suggests that paragraph (a) should be worded, "Primary flight controls must operate . . ." stating that Proposal 2-48 defines primary controls as including the collective. A third commenter makes this same suggestion and adds a paragraph to state that other controls must operate forward or up to increase the related controlled parameter as it is related to the rotorcraft axis.

Including the word "primary" would exclude consideration of secondary controls. The third commenter's suggested paragraph would cover only a limited number of considerations that are best covered in guidance material.

A fourth commenter suggests that proposed paragraph (c) state that the normal landing gear control operate downward rather than just landing gear control, since emergency landing gear controls may require different actions. This suggestion is accepted and the amendment is adopted with this change.

Proposal 2-53. See explanation for Proposal 2-20. This amendment is adopted with the same change as identified for Proposal 2-20.

Proposal 2-54. No comments were received on the proposal to delete paragraphs (f) and (g) of § 29.811 and redesignate the remaining paragraphs. The proposal is adopted without change.

Proposal 2-55. One commenter agrees with the proposal. The FAA notes that the proposal was not clear in allowing the emergency lighting system to share common sources of illumination (bulbs) with the normal cabin lighting system provided the power supplies are independent. Therefore, § 29.812(a) is revised as follows: "(a) A source of light with its power supply independent of the main lighting system must be installed to . . . ."

A second commenter suggests that the cockpit control device in proposed § 29.812(b) could have either "off," "on," and "armed" positions or "off" and a common "on/armed" positions. The control device in the cockpit needs an "on" position (sometimes referred to as "test") to allow the crew to preflight check the emergency lights and to turn on the emergency lights when the normal rotorcraft power is not interrupted. The FAA agrees that the wording of this paragraph could be improved; therefore, the second sentence of § 29.812(b) is revised as follows: "The cockpit control device must have an 'on,' 'off,' and 'armed' position so that when turned on at the cockpit or passenger compartment station or when armed at the cockpit station, the emergency lights will either illuminate or remain illuminated upon interruption of the rotorcraft's normal electric power."

A third commenter suggests that the exterior emergency lighting in proposed § 29.812(c) could be provided by internal or external sources with intensity measurements made with the normal exits open. The FAA concurs except the measurements would be made with only the emergency exits open. Therefore, the following is added: "The exterior emergency lighting may be provided by either interior or exterior sources with light intensity measurements made with the emergency exits open."

Further FAA review notes that the method of activating the exterior lighting in § 29.812(c) is not stated. To correct this, proposed paragraph (c) will be reidentified as paragraph (b) and proposed paragraph (b) reidentified as paragraph (c). The first sentence of new paragraph (c) is revised to read: "Each light required by paragraph (a) or (b) of this section . . . ." The proposed amendment is adopted with the noted changes.

Proposal 2-56. Only one comment was received, and it agrees with the proposal.

Proposal 2-57. One commenter agrees with the proposal to add the requirement for a maximum allowable airspeed indicator and warning system for certain Category A rotorcraft in § 29.1303. A second commenter suggests that a radar altimeter should be mandatory for Part 29 helicopters and there should be criteria to establish maximum allowable vibration; these suggestions are beyond the scope of the Notice.

A third commenter states that V_{NE} is defined as the never-exceed speed and that structural substantiations do not cover any intentional operation above V_{NE}, so the warning should operate at V_{NE} and above (with up to 5 knots below V_{NE} for production tolerance). This commenter suggests that establishing a normal operating speed limit, V_{NO}, below V_{NE} would solve the problem of nuisance operation of the warning at, or near, the allowable speed.

A fourth commenter suggests deleting the proposed change, stating that airspeeds greater than V_{NE} (up to at least 1.1 V_{NE}) are already considered in substantiating the structural adequacy and flight characteristics of the rotorcraft. This commenter further states that the added cost, weight, and complexity are not warranted by service experience, and questions whether a single system would suffice. In support of the question, this commenter explains the complexity in accounting for factors which can affect V_{NE}, such as power-on vs. power-off flight, gross weight, rotor speed, pressure altitude, and outside air temperature. This commenter leads the FAA to conclude that if it is this complex to determine V_{NE} (and, in fact, it is), then there is all the more reason to provide the pilot some assistance. As to the differences between the third and fourth commenters' interpretation of structural and flight verification above V_{NE}, (to 1.1 V_{NE}), the fourth commenter is correct in that intentional flight above V_{NE} is not permitted but the substantiation analysis and tests required do account for infrequent and inadvertent excursions beyond V_{NE}. Therefore, establishing a warning below V_{NE} is not necessary and requiring the warning to operate 3 knots above V_{NE} is appropriate to allow flight at V_{NE} without nuisance warnings. As rotorcraft have become larger and longer flights scheduled, fuel used has become a significant percentage of gross weight. To establish a

V_{NE} based on maximum gross weight as is presently done precludes more economical operations at higher airspeeds as the flight progresses and the weight is reduced through fuel consumption. The proposed V_{NE} indicator would enhance the capability for this more economical operation.

The fourth commenter also suggests eliminating the warning device to be consistent with the suggestion to eliminate the V_{NE} indicator requirement, and further, that an aural warning could degrade the overall safety level by adding to the number of aural warnings now used; for example, fire, engine out, and landing gear. The third commenter also suggests that a warning light is sufficient. The proposal specifically states that the aural warning must differ distinctively from aural warnings used for other purposes so that there should be no confusion and the safety level would be enhanced. The proposal requires the V_{NE} indicator and warning only when other pilot cues are not provided; under these circumstances, a light, without aural warning, would more likely be overlooked. Accordingly, the amendment is adopted as proposed.

Proposal 2-58. One commenter agrees with the proposal. A second commenter assumes that proposed § 29.1309(b) (2) (i) would apply to the rotor and transmission systems since § 29.1309(a) refers to "this subchapter." This commenter's concern is that the proposed amendment would impose an extremely improbable failure requirement, defined as 1×10^{-9} or less per flight hour in Advisory Circular (AC) 29-2, Certification of Transport Category Rotorcraft, and AC 25.1309-1, System Design Analysis. The commenter states experience has shown the rotor and transmission systems failure rate to be only 1×10^{-6} at best. The FAA acknowledges that, as proposed, this section could be interpreted to include consideration of rotor and transmission systems, although the specific requirements for these systems are primarily contained in §§ 29.571, 29.901, 29.917, and 29.923. As noted in AC 29-2, § 29.1309 includes "but is not limited to electrical, pneumatic, and hydraulic power sources, associated distribution, and corresponding utilization systems," indicating, by these examples, the systems to which § 29.1309 is most applicable. There are other rotorcraft "systems" such as landing gear, propulsion, and fuselage that do not meet the 1×10^{-9} failure rate probability. To single out the rotor and transmission systems in this section is not appropriate. The general wording and concepts of this section have not caused problems in this area during past certifications.

The second commenter also notes that the term "improbable," as used in the proposed § 29.1309(b) (2) (ii) and as defined in AC 29-2, covers a failure rate range from 1×10^{-5} to 1×10^{-9}, which is too broad to be meaningful. This comment implies a need for an intermediate descriptive term and associated failure rate. Inclusion of such a term and associated failure rate would be more restrictive than the proposal since those systems to which the intermediate term would apply could be certificated under the proposal with a failure rate of only 10^{-5} per flight hour.

A third commenter questions the meaning and rationale for the phrases, "do not cause a hazard" (proposed § 29.1309(b) (1)), "prevent hazards" (proposed § 27.1309(b)), and "minimize hazards" (proposed § 27.1309(c)). In response to this comment, the FAA finds the phrase "do not cause a hazard" inappropriate since no difference in meaning is intended between the present § 29.1309(b) and proposed § 29.1309(b) (1) for Category B rotorcraft. Therefore, proposed § 29.1309(b) (1) is revised to read, "For Category B rotorcraft, the equipment, systems, and installations must be designed to prevent hazards to the rotorcraft if they malfunction or fail." The phrase "minimize hazards", as contrasted with "prevent hazards," allows (1) a level of safety that is compatible with single-engine rotorcraft, (2) less complexity, and (3) less costly systems and equipment. This lower level of safety for single-engine normal category rotorcraft is intended to permit practical designs that minimize weight and cost penalties.

A fourth commenter suggests combining proposed § 29.1309(b) (2) (i) and (ii) to state: "(2) For Category A rotorcraft, the equipment systems and installations must not prevent the continued safe flight and landing or cause injury to the occupants if they malfunction or fail, unless the malfunction or failure is shown to be extremely improbable." This suggestion would be more restrictive since it establishes the "extremely improbable" condition for a failure that only reduces the capability of the rotorcraft or crew. The FAA has also determined that injury to occupants is not a proper factor to be required in this analysis and this reference is deleted. This agrees with Part 25 in this area. For this reason, the suggestion is beyond the scope of the Notice. The commenter also refers to the National Transportation Safety Board (NTSB) Review of Rotorcraft Accidents 1977–1979 and quotes the document as showing that only 2.7 percent of the accidents were due to systems, instruments, and equipment. The FAA finds that during the 1977 to 1979 period, instrument-flight-equipped helicopters were a small percentage of the total helicopter fleet. This small percentage is not representative of the present fleet and it is projected to be even less representative each year. This is largely due to a rapid progression to increased system complexity from that of the 1977 to 1979 period. Systems such as electronic flight instrument systems (EFIS), fly-by-wire, and electronic fuel controls are now being presented for approval or are on the threshold of being presented. Loss of any one of these systems during instrument flight or loss of fly-by-wire or electronic fuel controls in any flight operation could be catastrophic. Therefore, the provisions of proposed § 29.1309(b) (2) (i) and (ii) are necessary to assure an adequate level of safety and are adopted.

The fourth commenter and a fifth commenter also suggest deleting the last sentence of the proposed § 29.1309(c) which requires designs to minimize crew errors which could create additional hazards. Both commenters state that it is too broad for clear application. While the requirement is broadly stated, there is a need to assure that installations such as identical switches, one frequently used and one infrequently used, such as fuel shutoff, are not placed side by side. It is impracticable to list all such poor design possibilities and the requirement is adopted as proposed.

The fourth and fifth commenters also suggest that the entire proposed § 29.1309(d) be deleted as it is "how to" which should only be in advisory circular material. This paragraph defines certain failure analysis criteria that can be stated clearly in the requirements. Accordingly, the amendment is adopted as proposed.

Proposal 2-59. This proposal would revise the airspeed system accuracy requirements of § 29.1323 to consider Category A and Category B flight profiles instead of differentiation by number of engines and to clarify that the requirements do not include instrument errors. One commenter states that since an airspeed error of not more than 5 knots is achievable, it should not be relaxed to 10 knots in a climb. Meeting the 10-knot error in a climb has been difficult for some rotorcraft and has resulted in complex systems or configurations requiring precise positioning of components. Retaining only a 5-knot error in a climb would not resolve these problems. The original conference proposal to allow a 15-knot error is an indication of the difficulties encountered in this area, but was considered to be excessive. A 10-knot error appears to be the best compromise between system complexity and safe, realistic indications. This same commenter suggests that the limit of a 3 percent error be deleted since an airspeed of 167 knots is required before it becomes a benefit. While 167 knots exceeds V_{NE} for most present-day rotorcraft, the proposal provides a design standard for the few present and any future rotorcraft with a V_{NE} greater than 167 knots.

A second commenter suggests that the minimum calibration speed in level flight be 30 knots rather than the proposed 20 knots because the difference is insignificant and does not improve safety or provide necessary information. The present rule requires single-engine rotorcraft systems to be calibrated at 20 knots and above, but requires calibration at 30 knots and above for multiengine rotorcraft. Amendment 29–3, effective February 25, 1968, changed the calibration requirement from 10 mph to the present 20 knots. Notice 82–12 explained the need for low-speed accuracy requirements for Category A operations. Accordingly, the amendment is adopted as proposed.

Proposal 2-60. This proposed change to § 29.1325(f) would relax the transport rotorcraft static system accuracy of ±30 feet at all airspeeds to ±30 feet per 100 knots airspeed as currently required for transport airplanes. One commenter agrees with the proposal and states that Part 27 should reflect the same level of accuracy as that required by Part 29. There is no comparable requirement in Part 27 and one was not proposed. Therefore, this suggestion is beyond the scope of the Notice. A second commenter notes that as written, the proposal would require zero altitude error at zero airspeed and suggests including the sentence from Part 25 which states that the error need not be less than ± 30 feet. The FAA agrees and the amendment is changed to reflect that wording. A third commenter suggests changing the requirement to an allowable error of no more than ± 30 feet below 100 knots or ± 60 feet at higher speeds since there is no foreseeable need to consider speeds above 200 knots. However, the proposed amendment includes speeds above 200 knots and will not require a rule change if the unforeseeable does occur. Accordingly, the amendment is adopted with the change described.

Proposal 2-61. This proposal would clarify the design requirements for autopilots used in transport category rotorcraft and would add requirements in § 29.1329(e) for autopilots when interconnecting them with other systems. One commenter agrees with the proposal. A second commenter suggests that where an autopilot failure can result in hazardous effects on the control of the rotorcraft, a disengage control should be required to be on the cyclic control. Hazardous effects after a failure are precluded by compliance with the current § 29.1329(d). Requiring the disengaging control on the cyclic was discussed at the review conference and sufficient justification was provided to require only readily available disengagement. This decision is discussed in Notice 82-12, the major factor being that autopilot design must permit the pilot to control the rotorcraft first by overpowering a malfunctioning system, then disconnecting it. Where crew action is necessary to prevent a hazardous situation, this commenter suggests requiring a system to indicate the autopilot mode of operation and warning if it ceases to operate correctly. While the commenter's recommendation is beyond the scope of the Notice, the suggestion for indicating the mode of operation is retained for possible future action. Accordingly, the amendment is adopted as proposed.

Proposal 2-62. This proposed revision would modify the requirement for a power adequacy indicator for each required flight instrument. It would define the point at which required power measurements must be made. One commenter agrees with the proposal. A second commenter suggests that the term "required flight instrument" in current § 29.1331(a) should be clarified and recommends using Part 25 as an example. The commenter notes that this is beyond the scope of the Notice and recommends that Advisory Circular 29-2 address this question. Considering the definition of "instrument" in § 1.1, the FAA considers this section adequate as written but agrees that a discussion of the term "required" is appropriate for future revisions of AC 29-2. The amendment is adopted as proposed.

Proposal 2-63. The Notice contained a typing error which identified the proposals for §§ 29.1333 and 29.1335 both as Proposals 2-63 and no Proposal 2-64. This did not appear to cause a problem since only one commenter addressed these proposals and the comments were identified by section number, not proposal number. The commenter agrees with both proposals. The proposal for § 29.1333 would revise the requirements for instrument systems to reflect the increased complexity of instrumentation available, used, and necessary for transport rotorcraft to operate safely in the extreme range of operating environments to which they are now routinely exposed. The proposal for § 29.1335 would require Category B rotorcraft to meet the same electrical power source standards for required equipment and systems as are required for Category A rotorcraft. It further proposes wording as to the manner in which electrical power is maintained under fault conditions. The intent is to require two independent electrical power sources for essential load circuits for transport category rotorcraft. Accordingly, both amendments are adopted as proposed.

Proposal 2-65. This proposal would revise § 29.1357 by requiring Category B rotorcraft to have the overvoltage protection now required for Category A rotorcraft, by clarifying that all parts of a single essential system may be protected by the same circuit protective device, and by specifically stating under what circumstances automatic reset circuit breakers may be used. One commenter agrees with the proposal. A second commenter agrees with the proposal, but requests the term "essential to safety of flight" be well defined in Advisory Circular 29-2. This will be done. The amendment is adopted as proposed.

Proposal 2-66. Only one comment was received and it agreed with the proposal.

Proposal 2-67. This proposal would change the wording of § 29.1525 to clarify the requirements for approved kinds of operation without affecting the actual certification process. One commenter agrees with the proposal. A second commenter suggests that the list of kinds of operations be expanded to include all typical kinds and to require, by § 29.1583(e) the flight manual to include the appropriate compliance status with § 29.1525. The proposal lists, as examples, all such kinds of operations except external-load carrying that are applicable to certification. Specific uses, such as passenger-carrying, power-line patrol, logging operations, etc., are huge in number and not a basic certification requirement. Section 29.1583(e) presently requires that the flight manual list the approved kinds of operations. Since kinds of operations are defined in § 29.1525, there is no need to repeat them in § 29.1583. Accordingly, the amendment is adopted as proposed.

Proposal 2-68. This proposed revision to § 29.1555(a) would remove flight controls and other obvious control functions from the marking requirements for cockpit controls. The proposed change to § 29.1555(e) would require a placard stating the maximum landing gear operating speed (V_{LO}) in rotorcraft with retractable gear. One commenter agrees with the proposal. A second commenter proposes deleting the requirement for a V_{LO} placard near the landing gear control. This is discussed under Proposal 2-28. The same change to require a limit speed placard in clear view of the pilot is included in this amendment. A third commenter suggests that a rotorcraft could have a V_{LE} different from V_{LO} and that this should also be placarded. Where V_{LE} and V_{LO} are different, the landing gear operating speed normally is less than the landing gear extended speed. Requiring only V_{LO} would be the most conservative, but would not preclude placards of other speeds where appropriate. This third commenter also suggests that standardization (shape and color) of controls should be added to the rule with detail information in Advisory Circular 29-2. This suggestion is beyond the scope of this notice. The amendment is adopted with the change identified in Proposal 2-28.

Proposal 2-69. This proposal would remove the requirement for a placard which states that the rotorcraft must comply with the operating limitations contained in the rotorcraft flight and maintenance manuals. The required placard, containing over 50 words, was redundant to requirements specified elsewhere in the certification and operating rules. A much shorter placard was proposed. One commenter supports the proposal. A second commenter recommends the limitations placard reference the flight manual for information on limits. This same comment was made for Proposal 2-29; see that proposal for explanation. The amendment is adopted without change.

Proposal 2-70. This proposal implements an existing practice by specifying ambient temperature as an operating limitation. The proposal also adds the maximum allowable wind for safe operation near the ground as a limitation for transport Category A rotorcraft. One commenter agrees with the proposal but states that the explanation for excluding Category B rotorcraft from the maximum allowable wind limitation is not complete and the information should be included in the performance section of the flight manual. Proposal 2-72 does require the maximum demonstrated wind for safe operation near the ground as performance information for Category B rotorcraft. A second commenter suggests that the proposal be expanded to indicate more clearly that the sideward and rearward flight limits for crosswinds and tailwinds established by § 29.143(c) are the limits of concern. Section 29.143(c) is a controllability and maneuverability requirement. However, such factors as engine stall or surge due to inlet distortion, rotorcraft attitudes that could influence the unusable fuel quantity, and structural considerations also have been encountered as limiting conditions for maximum winds. Although these examples influenced the limits established for compliance with § 29.143(c), the controllability and maneuverability, in the narrowest sense, were not the limiting factors. Therefore, it is not appropriate to specify that this proposal is concerned only with § 29.143(c).

A third commenter states that the proposal seems appropriate, but goes on to state that the explanation implies restrictions to operations which would not be practicable or acceptable if operating to an unmanned site where wind and temperature information are not available. Under present VFR operating rules, when only area weather information is provided before departure, the pilot is responsible for evaluating the destination weather upon arrival. Under IFR operating rules, the pilot must be provided destination weather before beginning an instrument meteorological condition (IMC) approach. Therefore, the concerns of the third commenter are valid only under IMC where consideration must be given to several other IFR requirements that are more restrictive than those resulting from this proposal. The amendment is adopted as proposed.

Proposal 2-71. Only one comment was received and it agrees with the proposal.

Proposal 2-72. Three commenters suggest that the proposed § 29.1587 restriction on showing performance information beyond any operating limit should be deleted. The first of these commenters states that performance information beyond operating limits is used to calculate the effect of optional equipment. The second and third of these commenters give examples where the maximum allowable gross weight is greater with an external load. Two of these commenters suggest shading or other methods to indicate limits. These techniques have merit and have been used on recently certificated rotorcraft; however, some proposed manuals have been submitted to FAA with data that greatly exceed several limits and with little or no indication of the limits. The wording of the amendment is changed as follows:

"Flight manual performance information which exceeds any operating limitation may be shown only to the extent necessary for presentation clarity or to determine the effects of approved optional equipment or procedures. When data beyond operating limits are shown, the limits must be clearly indicated."

A fourth commenter suggests that instead of requiring the maximum demonstrated wind for starting and stopping the rotors in proposed § 29.1587(a) (4) and (b) (4), the maximum recommended wind should be required. Difficulty in obtaining the needed wind conditions for demonstration is cited as the major objection to the proposed wording. A fifth commenter states that even though the maximum demonstrated wind would appear under performance information, it would be interpreted as a limit. A sixth commenter suggests that a minimum of 17-knots wind, to be compatible with the control and maneuverability requirements, be required for the demonstration.

Guidance on rotor characteristics during starting and stopping is very desirable. However, there are so many variables to be considered that significant questions are raised on the capability to develop and verify adequate information without large and expensive analysis and test programs. A few of the wind-related variables that must be considered are wind velocity, gust magnitude, gust frequency, relative direction of the wind, and turbulence—natural and object induced. Imposed upon the wind factors are the rotor design, aerodynamic characteristics, and control techniques. Demonstrations (or recommendations) that address only a steady wind could be misleading. The FAA considers information on rotor characteristics during start and stop as highly desirable and encourages the manufacturers to provide as much guidance as feasible. However, in view of the difficulty and expense that would be required to develop and evaluate even an absolute minimum of data, the proposal to require the maximum wind for starting and stopping the rotors is withdrawn.

A seventh commenter suggests that the last sentences of proposed § 29.1587(a) (5) and (6) be deleted. These sentences state that the distances determined for takeoff under § 29.59 and landing under §§ 29.75 and 29.77 must be used in establishing takeoff and landing field lengths. The commenter is correct in stating that these sentences are unnecessary; therefore, they are deleted.

An eighth commenter objects to proposed § 29.1587(b)(6) which requires glide distance as a function of altitude. This commenter states that this is useless information and suggests that the speeds for minimum rate of descent and best glide angle with the associated glide angles be required. Requirements to provide the speeds associated with minimum rate of descent and best glide angle are included in § 29.1585 (Proposal 2-71). As discussed in the Notice, glide distance as a function of altitude is more readily usable information than just glide angle. Accordingly, this portion of the amendment is adopted as proposed.

A ninth commenter suggests that out-of-ground-effect hover performance information should be required for all transport category rotorcraft. This is beyond the scope of the Notice.

Amendment 29-21, effective after publication of Notice 82-12, added a new § 29.1587(b)(6). Therefore, the proposal is edited as necessary and is adopted as discussed.

Proposal 2-73. One commenter suggests that the proposed title of § 91.31 be changed to "Civil aircraft operating limitations." This section includes the requirements for markings and placards in older aircraft that do not require flight manuals. Therefore, the title proposed in the Notice is more descriptive of the section. FAA review notes that the proposed wording could be interpreted to require compliance with only flight manual, marking, or placard operating limitations. Experimental aircraft, which includes amateur-built aircraft, do not require a flight manual, markings, or placards, but operating limitations normally are issued with the airworthiness certificate. To provide for this example, or any other similar case, the last phrase is revised to read: ", or as otherwise prescribed by the certificating authority of the country of registry," and the amendment is adopted.

ECONOMIC SUMMARY

The FAA conducted an evaluation of the economic impact of these regulatory changes. A copy of the evaluation has been placed in the docket.

The assumptions used in preparing the economic impact estimates of the changes to the certification regulations are derived from earlier cost impact assessments of the proposals contained in Notice 82-12. Notice 82-12 invited public comments concerning technical and operational considerations and economic impact assumptions as they apply to rotorcraft performance, flight characteristics, systems, and equipment. Comments on the proposal were submitted by domestic and foreign manufacturer and operator trade associations. The majority of the comments recommend minor technical modifications and editorial clarifications. A number of comments, however, disagree with the economic impact estimates of various proposals. The FAA has evaluated the public comments and made final determinations regarding their impact. With only one exception, the FAA finds that the proposals determined to have an economic impact at the NPRM stage of rulemaking will also have an economic impact if the rule is adopted. The one exception is that the estimated savings resulting from § 29.175 is reduced from $50,000 per certification to a negligible amount as a result of industry comments and subsequent FAA technical amendments.

The five amendments determined to have an economic impact are related to limiting height-speed envelope, lightning protection for Parts 27 and 29 rotorcraft, providing of a means that will allow the pilot to determine that full control authority is available prior to flight for transport category rotorcraft, and adding an aural, never-exceed-speed indicator as a requirement for Part 29 certification. The evaluation of these amendments is summarized in Table 1.

Table 1
Costs and Savings of NPRM 2 Changes Having Economic Impacts

Proposal	*Cost (Savings)*	*Benefits*
27.79 *Limiting Height-Speed Envelope* Revision of the weight requirements needed to establish performance at various altitudes.	($50 thousand per certification)	Reduction of Flight testing time by 10 hours and demonstration weight by approximately 15% at altitudes above sea level.
29.671 *Control Systems: General* The provisions of a means performing a control command verification procedure prior to flight in rotorcraft with boosted flight control systems.	5.2 million total incurred for first three production years.[1]	Benefit not quantified. Undetermined benefits are expected to accrue to operators and travelers by the prevention of accidents attributed to flight control system failures.
27.610 *Lightning Protection* (See 29.610)	(See 29.610)	(See 29.610)
29.610 *Lightning Protection* The protection of digital/electronic avionic and flight control systems against the disruptive effects of lightning strikes. The rule places special emphasis on rotorcraft with composite material primary and secondary flight structures	The FAA requested industry comments on the cost of the lightning protection requirements of this section. Commentors did not provide cost data analysis required on the design and data analysis required to protect advanced digital avionics flight control systems will be furnished by a major FAA, NASA, and DOD task force research effort. The results of this study are expected to minimize the cost impact and the FAA believes that the rule will be cost beneficial.	The FAA believes that benefits will accrue to operators and travelers by the prevention of accidents attributed to the catastrophic effects of lightning strikes on critical avionics, flight control systems, structures, and fuel systems.
29.1303 Flight and Navigation Instruments	$1.1 million total incurred for first three production years, including maintenance costs.[2]	The provision of maximum allowable airspeed indicating system is expected to prevent Fatigue failure accidents attributed to overspeed conditions. On the basis of the $2.0 million average cost of fatigue failure accidents, the amendment would have to prevent less than one accident to justify its costs.

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[1] Cost estimates are based on the addition of an electronic motor to allow full control movement prior to flight the FAA did not receive comments on the cost of implementing alternative means of complying with the proposal.

[2] The cost estimate is based on an instrumentation developed by one manufacturer to provide V_{NE} measurement and warning capability and to perform a power assurance check. The costs shown here are those attributable to the V_{NE} indicator and V_{NE} over speed warning device. The cost shown should provide an instrument that meets all safety aspects and gives a true speed measurement under all factors which can use V_{NE} to vary.

REGULATORY FLEXIBILITY DETERMINATION

The FAA has determined that under the criteria of the Regulatory Flexibility Act (RFA) of 1980, the amendments to Parts 1, 27, 29, and 91 contained in this final rule, at promulgation, will not have a significant economic impact on a substantial number of small entities. The RFA requires agencies to specifically review rules which may have a "significant economic impact on a substantial number of small entities." The FAA recently adopted criteria and guidelines for rulemaking officials to apply when determining if a proposed or existing rule has a significant economic impact on a substantial number of small entities and guidance for the conduct of regulatory flexibility analyses and reviews. The FAA small entity size standards criteria define a small helicopter manufacturer as an independently owned and managed firm having fewer than 75 employees. Under the FAA size standard criteria, only one manufacturer subject to the certification changes to Parts 1, 27, 29, and 91 has fewer than 75 employees. Table 2 shows domestic helicopter manufacturers and designation as to size. Accordingly, the amendments to Parts 1, 27, 29, and 91 contained in this final rule will not impact a substantial number of small entities.

There are no known diseconomies of scale associated with the anticipated marginal increase in certification costs. This change to the certification rules for Parts 27 and 29 helicopter manufacturers is not perceived to raise any barrier to entry into this market for small manufacturers.

Table 2

Parts 27 and 29 Rotorcraft Manufacturers

Part 27 Manufacturers	*Firm Size*
Brantly-Hynes Helicopters, Inc.	Small
Enstrom Helicopters Corp.	Large
Hiller Aviation	Large
Hughes Helicopters, Inc.	Large
Kaman Aerospace	Large
Robinson Helicopters	Large
Part 29 Manufacturers	*Firm Size*
Bell Helicopter Textron, Inc.	Large
Boeing Vertol Company	Large
Sikorsky Aircraft—United Technologies	Large

Paperwork Reduction Act Statement

This final rule does not contain a new or amended information collection requirement subject to the Paperwork Reduction Act of 1980 (44 U.S.C.3501 et seq). Existing requirements were approved by the Office of Management and Budget approval number 2120-0018.

ADOPTION OF THE AMENDMENT

Accordingly, Parts 1, 27, 29, and 91 of the Federal Aviation Regulations (14 CFR Parts 1, 27, 29, and 91) are amended effective December 6, 1984.

(Secs. 313(a), 601, and 603, Federal Aviation Act of 1958, as amended (49 U.S.C. 1354(a), 1421, 1423 and 1424); 49 U.S.C. 106(g) (revised, Pub. L. 97-449, January 12, 1983))

NOTE: As summarized in the Supplementary Information, Discussion of Comments, Economic Summary, and Regulatory Flexibility Determination sections of this rulemaking action, the FAA has determined that the benefits of this amendment, in providing an increased level of safety to passengers traveling in rotorcraft while at the same time recognizing and providing for the unique qualities and capabilities of rotorcraft, far outweigh the burdens and that this action (1) involves a regulation that is not a major rule under Executive Order 12291; and (2) is not a significant rule under Department of

Transportation Regulatory Policies and Procedures (44 FR 11034; February 26, 1979). In addition, for reasons discussed above, I certify that under the criteria of the Regulatory Flexibility Act these amendments will not have a significant economic impact on a substantial number of small entities. Also, these amendments would have little or no impact on trade oportunities for U.S. firms doing business overseas or for foreign firms doing business in the United States. A final regulatory evaluation prepared for this action is contained in the regulatory docket. A copy of it may be obtained by contacting the person identified under the caption "FOR FURTHER INFORMATION CONTACT."

Part 27—Airworthiness Standards: Normal Category Rotorcraft

Subpart A—General

§ 27.1 Applicability.

This Part prescribes airworthiness standards for the issue of type certificates, and changes to those certificates, for normal category rotorcraft with maximum weights of 6,000 pounds or less.

(b) Each person who applies under Part 21 for such a certificate or change must show compliance with the applicable requirements of this Part.

Subpart B—Flight

GENERAL

§ 27.21 Proof of compliance.

[Each requirement of this subpart must be met at each appropriate combination of weight and center of gravity within the range of loading conditions for which certification is requested. This must be shown—

[(a) By tests upon a rotorcraft of the type for which certification is requested, or by calculations based on, and equal in accuracy to, the results of testing; and

[(b) By systematic investigation of each required combination of weight and center of gravity if compliance cannot be reasonably inferred from combinations investigated.]

§ 27.25 Weight limits.

(a) *Maximum weight.* The maximum weight (the highest weight at which compliance with each applicable requirement of this Part is shown) must be established so that it is—

(1) Not more than—

(i) The highest weight selected by the applicant;

(ii) The design maximum weight (the highest weight at which compliance with each applicable structural loading condition of this Part is shown); or

(iii) The highest weight at which compliance with each applicable flight requirement of this Part is shown; and

(2) Not less than the sum of—

(i) The empty weight determined under § 27.29;

(ii) The weight of usable fuel appropriate to the intended operation with full payload;

(iii) The weight of full oil capacity; and

(iv) For each seat, an occupant weight of 170 pounds or any lower weight for which certification is requested.

(b) *Minimum weight.* The minimum weight (the lowest weight at which compliance with each applicable requirement of this Part is shown) must be established so that it is—

(1) Not more than the sum of—

(i) The empty weight determined under § 27.29; and

(ii) The weight of the minimum crew necessary to operate the rotorcraft, assuming for each crewmember a weight no more than 170 pounds, or any lower weight selected by the applicant, or included in the loading instructions; and

(2) Not less than—

(i) The lowest weight selected by the applicant;

(ii) The design minimum weight (the lowest weight at which compliance with each applicable structural loading condition of this Part is shown); or

(iii) The lowest weight at which compliance with each applicable flight requirement of this Part is shown.

(c) *Total weight with jettisonable external load.* A total weight for the rotorcraft with jettisonable external load attached that is greater than the maximum weight established under paragraph (a) of this section may be established is structural component approval for external load operations under Part 133 of this chapter is requested and the following conditions are met.

(1) The portion of the total weight that is greater than the maximum weight established under paragraph (a) of this section is made up only of the weight of all or part of the jettisonable external load.

(2) Structural components of the rotorcraft are shown to comply with the applicable structural requirements of this Part under the increased loads and stresses caused by the weight increase over that established under paragraph (a) of this section.

(3) Operation of the rotorcraft at a total weight greater than the maximum certificated weight established under paragraph (a) of this section is limited by appropriate operating limitations to rotorcraft external load operations under Part 133 of this chapter.

§ 27.27 Center of gravity limits.

The extreme forward and aft centers of gravity and, where critical, the extreme lateral centers of gravity must be established for each weight established under § 27.25. Such an extreme may not lie beyond—

(a) The extremes selected by the applicant;

(b) The extremes within which the structure is proven; or

(c) The extremes within which compliance with the applicable flight requirements is shown.

§ 27.29 Empty weight and corresponding center of gravity.

(a) The empty weight and corresponding center of gravity must be determined by weighing the rotorcraft without the crew and payload, but with—

(1) Fixed ballast;

(2) Unusable fuel; and

(3) Full operating fluids, including—

(i) Oil;

(ii) Hydraulic fluid; and

(iii) Other fluids required for normal operation of rotorcraft systems, except water intended for injection in the engines.

(b) The condition of the rotorcraft at the time of determining empty weight must be one that is well defined and can be easily repeated, particularly with respect to the weights of fuel, oil, coolant, and installed equipment.

§ 27.31 Removable ballast.

Removable ballast may be used in showing compliance with the flight requirements of this subpart.

§ 27.33 Main rotor speed and pitch limits.

(a) *Main rotor speed limits.* A range of main rotor speeds must be established that—

(1) With power on, provides adequate margin to accommodate the variations in rotor speed occurring in any appropriate maneuver, and is consistent with the kind of governor or synchronizer used; and

(2) With power off, allows each appropriate autorotative maneuver to be performed throughout the ranges of airspeed and weight for which certification is requested.

(b) *Normal main rotor high pitch limits (power-on).* For rotorcraft, except helicopters required to have a main rotor low speed warning under paragraph (e) of this section, it must be shown with power on and without exceeding approved engine maximum limitations, that main rotor speeds substantially less than the minimum approved main rotor speed will not occur under any sustained flight condition. This must be met by—

(1) Appropriate setting of the main rotor high pitch stop;

(2) Inherent rotorcraft characteristics that make unsafe low main rotor speeds unlikely; or

(3) Adequate means to warn the pilot of unsafe main rotor speeds.

(c) *Normal main rotor low pitch limits (power off).* It must be shown, with power off, that—

(1) The normal main rotor low pitch limit provides sufficient rotor speed, in any autoro-

tative condition, under the most critical combinations of weight and airspeed; and

(2) It is possible to prevent overspeeding of the rotor without exceptional piloting skill.

(d) *Emergency high pitch.* If the main rotor high pitch stop is set to meet paragraph (b) (1) of this section, and if that stop cannot be exceeded inadvertently, additional pitch may be made available for emergency use.

(e) *Main rotor low speed warning for helicopters.* For each single engine helicopter, and each multiengine helicopter that does not have an approved device that automatically increases power on the operating engines when one engine fails, there must be a main rotor low speed warning which meets the following requirements:

(1) The warning must be furnished to the pilot in all flight conditions, including power-on and power-off flights, when the speed of a main rotor approaches a value that can jeopardize safe flight.

(2) The warning may be furnished either through the inherent aerodynamic qualities of the helicopter or by a device.

(3) The warning must be clear and distinct under all conditions, and must be clearly distinguishable from all other warnings. A visual device that requires the attention of the crew within the cockpit is not acceptable by itself.

(4) If a warning device is used, the device must automatically deactivate and reset when the low-speed condition is corrected. If the device has an audible warning, it must also be equipped with a means for the pilot to manually silence the audible warning before the low-speed condition is corrected.

PERFORMANCE

§ 27.45 General.

(a) Unless otherwise prescribed, the performance requirements of this subpart must be met for still air and a standard atmosphere.

(b) The performance must correspond to the engine power available under the particular ambient atmospheric conditions, the particular flight condition, and the relative humidity specified in paragraphs (d) or (e) of this section, as appropriate.

(c) The available power must correspond to engine power, not exceeding the approved power, less—

(1) Installation losses; and

(2) The power absorbed by the accessories and services appropriate to the particular ambient atmospheric conditions and the particular flight condition.

(d) For reciprocating engine-powered rotorcraft, the performance, as affected by engine power, must be based on a relative humidity of 80 percent in a standard atmosphere.

(e) For turbine engine-powered rotorcraft, the performance, as affected by engine power, must be based on a relative humidity of—

(1) 80 percent, at and below standard temperature; and

(2) 34 percent, at and above standard temperature plus 50 degrees F. Between these two temperatures, the relevant humidity must vary linearly.

[(f) For turbine-engine-powered rotorcraft, a means must be provided to permit the pilot to determine prior to takeoff that each engine is capable of developing the power necessary to achieve the applicable rotorcraft performance prescribed in this subpart.**]**

§ 27.51 Takeoff.

(a) The takeoff, with takeoff power and r.p.m., and with the extreme forward center of gravity—

(1) May not require exceptional piloting skill or exceptionally favorable conditions; and

(2) Must be made in such a manner that a landing can be made safely at any point along the flight path if an engine fails.

(b) Paragraph (a) of this section must be met throughout the ranges of—

(1) Altitude, from standard sea level conditions to the maximum altitude capability of the rotorcraft, or 7,000 feet, whichever is less; and

(2) Weight, from the maximum weight at sea level) to each lesser weight selected by the

applicant for each altitude covered by subparagraph (1) of this paragraph.

§ 27.65 Climb: all engines operating.

(a) For rotorcraft other than helicopters—

(1) The steady rate of climb, at V_Y, must be determined—

(i) With maximum continuous power on each engine;

(ii) With the landing gear retracted; and

(iii) For the weights, altitudes, and temperatures for which certification is requested; and

(2) The climb gradient, at the rate of climb determined in accordance with paragraph (a) (1) of this section, must be either—

(i) At least 1:10 if the horizontal distance required to take off and climb over a 50-foot obstacle is determined for each weight, altitude, and temperature within the range for which certification is requested; or

(ii) At least 1:6 under standard sea level conditions.

(b) Each helicopter must meet the following requirements:

(1) V_Y must be determined—

(i) For standard sea level conditions;

(ii) At maximum weight; and

(iii) With maximum continuous power on each engine.

(2) If at any altitude within the range for which certification is requested, V_{NE} is less than V_Y the steady rate of climb must be determined—

(i) At the climb speed selected by the applicant at or below V_{NE};

(ii) Within the range from 2,000 feet below the altitude at which V_{NE} is equal to V_Y up to the maximum altitude for which certification is requested;

(iii) For the weights and temperature that correspond to the altitude range set forth in paragraph (b) (2) (ii) of this section and for which certification is requested; and

(iv) With maximum continuous power on each engine.

§ 27.67 Climb: one engine inoperative.

For multiengine helicopters, the steady rate of climb (or descent), at V_Y (or at the speed for minimum rate of descent), must be determined with—

(a) Maximum weight;

(b) One engine inoperative; and

(c) Maximum continuous power on the other engines and (for helicopters for which certification for the use of 30-minute power is requested) at 30-minute power.

[§ 27.71 Glide performance.

[For single-engine helicopters and multiengine helicopters that do not meet the Category A engine isolation requirements of Part 29 of this chapter, the minimum rate of descent airspeed and the best angle-of-glide airspeed must be determined in autorotation at—

[(a) Maximum weight; and

[(b) Rotor speed(s) selected by the applicant.]

§ 27.73 Performance at minimum operating speed.

(a) For helicopters—

(1) The hovering ceiling must be determined over the ranges of weight, altitude, and temperature for which certification is requested, with—

(i) Takeoff power;

(ii) The landing gear extended; and

(iii) The helicopter in ground effect at a height consistent with normal takeoff procedures; and

(2) The hovering ceiling determined under subparagraph (1) of this paragraph must be at least—

(i) For reciprocating engine powered helicopters, 4,000 feet at maximum weight with a standard atmosphere; or

(ii) For turbine engine powered helicopters, 2,500 feet pressure altitude at maximum weight at a temperature of standard + 40 degrees F.

(b) For rotorcraft other than helicopters, the steady rate of climb at the minimum operating speed must be determined, over the ranges of weight, altitude, and temperature for which certification is requested, with—

(1) Takeoff power; and

(2) The landing gear extended.

§ 27.75 Landing.

(a) The rotorcraft must be able to be landed with no excessive vertical acceleration, no tendency to bounce, nose over, ground loop, porpoise, or water loop, and without exceptional piloting skill or exceptionally favorable conditions, with—

(1) Approach or glide speeds appropriate to the type of rotorcraft and selected by the applicant;

(2) The approach and landing made with—

(i) Power off, for single-engine rotorcraft; and

(ii) For multiengine rotorcraft, one engine inoperative and with each operating engine within approved operating limitations; and

(3) The approach and landing entered from steady autorotation.

(b) Multiengine rotorcraft must be able to be landed safely after complete power failure under normal operating conditions.

§ 27.79 Limiting height—speed envelope.

(a) If there is any combination of height and forward speed (including hover) under which a safe landing cannot be made under the applicable power failure condition in paragraph (b) of this section, a limiting height-speed envelope must be established (including all pertinent information) for that condition, throughout the ranges of—

(1) Altitude, from standard sea level conditions to the maximum altitude capability of the rotorcraft, or 7,000 feet, whichever is less; and

[(2) Weight, from the maximum weight (at sea level) to the lesser weight selected by the applicant for each altitude covered by paragraph (a)(1) of this section. For helicopters, the weight at altitudes above sea level may not be less than the maximum weight or the highest weight allowing hovering out of ground effect, whichever is lower.]

(b) The applicable power failure conditions are—

(1) For single-engine helicopters, full autorotation;

(2) For multiengine helicopters, one engine inoperative (where engine isolation features ensure continued operation of the remaining engines), and the remaining engines at the greatest power for which certification is requested; and

(3) For other rotorcraft, conditions appropriate to the type.

FLIGHT CHARACTERISTICS

§ 27.141. General.

The rotorcraft must—

[(a) Except as specifically required in the applicable section meet the flight characteristics requirements of this subpart—

[(1) At the altitudes and temperatures expected in operation;]

(2) Under any critical loading condition within the range of weights and centers of gravity for which certification is requested;

(3) For power-on operations, under any condition of speed, power, and rotor r.p.m. for which certification is requested; and

(4) For power-off operations, under any condition of speed and rotor r.p.m. for which certification is requested that is attainable with the controls rigged in accordance with the approved rigging instructions and tolerances;

(b) Be able to maintain any required flight condition and make a smooth transition from any flight condition to any other flight condition without exceptional piloting skill, alertness, or strength, and without danger of exceeding the limit load factor under any operating condition probable for the type, including—

(1) Sudden failure of one engine, for multiengine rotorcraft meeting transport category A engine isolation requirements of Part 29 of this chapter; and

(2) Sudden, complete power failure, for other rotorcraft;

(3) Sudden, complete control system failures specified in § 27.695 of this Part; and

(c) Have any additional characteristic required for night or instrument operation, if certification for those kinds of operation is requested. Requirements for helicopter instrument flight are contained in Appendix B of this Part.

§ 27.143 Controllability and maneuverability.

(a) The rotorcraft must be safely controllable and maneuverable—

(1) During steady flight; and

(2) During any maneuver appropriate to the type including—

(i) Takeoff;

(ii) Climb;

(iii) Level flight;

(iv) Turning flight;

(v) Glide;

(vi) Landing (power on and power off); and

(vii) Recovery to power-on flight from a balked autorotative approach.

(b) The margin of cyclic control must allow satisfactory roll and pitch control at V_{NE} with—

(1) Critical weight;

(2) Critical center of gravity;

(3) Critical rotor r.p.m.; and

(4) Power off (except for helicopters demonstrating compliance with paragraph (e) of this section) and power on.

(c) A wind velocity of not less than 17 knots must be established in which the rotorcraft can be operated without loss of control on or near the ground in any maneuver appropriate to the type (such as crosswind takeoffs, sideward flight, and rearward flight), with—

(1) Critical weight;

[(2) Critical center of gravity;

[(3) Critical rotor r.p.m.; and

[(4) Altitude, from standard sea level conditions to the maximum altitude capability of the rotorcraft or 7,000 feet, whichever is less.]

(d) The rotorcraft, after (1) failure of one engine in the case of multiengine rotorcraft that meet transport category A engine isolation requirements, or (2) complete engine failure in the case of other rotorcraft, must be controllable over the range of speeds and altitudes for which certification is requested when such power failure occurs with maximum continuous power and critical weight. No corrective action time delay for any condition following power failure may be less than—

(i) For the cruise condition, one second, or normal pilot reaction time (whichever is greater); and

(ii) For any other condition, normal pilot reaction time.

(e) For helicopters for which a V_{NE} (power-off) is established under § 27.1505(c), compliance must be demonstrated with the following requirements with critical weight, critical center of gravity, and critical rotor r.p.m.:

(1) The helicopter must be safely slowed to V_{NE} (power-off), without exceptional pilot skill, after the last operating engine is made inoperative at power-on V_{NE}.

(2) At a speed of 1.1 V_{NE} (power-off), the margin of cyclic control must allow satisfactory roll and pitch control with power off.

[§ 27.151 Flight controls.

[(a) Longitudinal, lateral, directional, and collective controls may not exhibit excessive breakout force, friction, or preload.

[(b) Control system forces and free play may not inhibit a smooth, direct rotorcraft response to control system input.]

§ 27.161 Trim control.

The trim control—

[(a) Must trim any steady longitudinal, lateral, and collective control forces to zero in level flight at any appropriate speed; and]

(b) May not introduce any undesirable discontinuities in control force gradients.

§ 27.171 Stability: general.

The rotorcraft must be able to be flown, without undue pilot fatigue or strain, in any normal maneuver for a period of time as long as that expected in normal operation. At least three landings and takeoffs must be made during this demonstration.

[§ 27.173 Static longitudinal stability.

[(a) The longitudinal control must be designed so that a rearward movement of the control is necessary to obtain a speed less than the trim speed, and a forward movement of the control is necessary to obtain a speed more than the trim speed.

[(b) With the throttle and collective pitch held constant during the maneuvers specified in § 27.175(a) through (c), the slope of the control position versus speed curve must be positive throughout the full range of altitude for which certification is requested.

[(c) During the maneuver specified in § 27.175(d), the longitudinal control position versus speed curve may have a negative slope within the specified speed range if the negative motion is not greater than 10 percent of total control travel.]

§ 27.175 Demonstration of static longitudinal stability.

(a) *Climb.* Static longitudinal stability must be shown in the climb condition at speeds from 0.85 V_Y to 1.2 V_Y, with—

(1) Critical weight;

(2) Critical center of gravity;

(3) Maximum continuous power;

(4) The landing gear retracted; and

(5) The rotorcraft trimmed at V_Y.

(b) *Cruise.* Static longitudinal stability must be shown in the cruise condition at speeds from 0.7 V_H or 0.7 V_{NE}, whichever is less, to 1.1 V_H or 1.1 V_{NE}, whichever is less, with—

(1) Critical weight;

(2) Critical center of gravity;

(3) Power for level flight at 0.9 V_H or 0.9 V_{NE}, whichever is less;

(4) The landing gear retracted; and

(5) The rotorcraft trimmed at 0.9 V_H or 0.9 V_{NE}, whichever is less.

(c) *Autorotation.* Static longitudinal stability must be shown in autorotation at airspeeds from 0.5 times the speed for minimum rate of descent to V_{NE}, or to 1.1 V_{NE} (power-off) if V_{NE} (power-off) is established under § 27.1505(c), and with—

(1) Critical weight;

(2) Critical center of gravity;

(3) Power off;

(4) The landing gear—

(i) Retracted; and

(ii) Extended; and

(5) The rotorcraft trimmed at appropriate speeds found necessary by the Administrator to demonstrate stability throughout the prescribed speed range.

[(d) *Hovering.* For helicopters, the longitudinal cyclic control must operate with the sense and direction of motion prescribed in § 27.173 between the maximum approved rearward speed and a forward speed of 17 knots with—

[(1) Critical weight;

[(2) Critical center of gravity;

[(3) Power required to maintain an approximate constant height in ground effect;

[(4) The landing gear extended; and

[(5) The helicopter trimmed for hovering.

[§ 27.177 Static directional stability.

[Static directional stability must be positive with throttle and collective controls held constant at the trim conditions specified in § 27.175(a) and (b). This must be shown by steadily increasing directional control deflection for sideslip angles up to ±10° from trim. Sufficient cues must accompany sideslip to alert the pilot when approaching sideslip limits.]

GROUND AND WATER HANDLING CHARACTERISTICS

§ 27.231 General.

The rotorcraft must have satisfactory ground and water handling characteristics, including freedom from uncontrollable tendencies in any condition expected in operation.

§ 27.235 Taxiing condition.

The rotorcraft must be designed to withstand the loads that would occur when the rotorcraft is taxied over the roughest ground that may be reasonably be expected in normal operation.

§ 27.239 Spray characteristics.

If certification for water operation is requested, no spray characteristics during taxiing, takeoff, or landing may obsure the vision of the pilot or damage the rotors, propellers, or other parts of the rotorcraft.

§ 27.241 Ground resonance.

The rotorcraft may have no dangerous tendency to oscillate on the ground with the rotor turning.

MISCELLANEOUS FLIGHT REQUIREMENTS

§ 27.251 Vibration.

Each part of the rotorcraft must be free from excessive vibration under each appropriate speed and power condition.

Subpart C—Strength Requirements

General

§ 27.301 Loads.

(a) Strength requirements are specified in terms of limit loads (the maximum loads to be expected in service) and ultimate loads (limit loads multiplied by prescribed factors of safety). Unless otherwise provided, prescribed loads are limit loads.

(b) Unless otherwise provided, the specified air, ground, and water loads must be placed in equilibrium with inertia forces, considering each item of mass in the rotorcraft. These loads must be distributed to closely approximate or conservatively represent actual conditions.

(c) If deflections under load would significantly change the distribution of external or internal loads, this redistribution must be taken into account.

§ 27.303 Factor of safety.

Unless otherwise provided, a factor of safety of 1.5 must be used. This factor applies to external and inertia loads unless its application to the resulting internal stresses is more conservative.

§ 27.305 Strength and deformation.

(a) The structure must be able to support limit loads without detrimental or permanent deformation. At any load up to limit loads, the deformation may not interfere with safe operation.

(b) The structure must be able to support ultimate loads without failure. This must be shown by—

(1) Applying ultimate loads to the structure in a static test for at least three seconds; or

(2) Dynamic tests simulating actual load application.

§ 27.307 Proof of structure.

(a) Compliance with the strength and deformation requirements of this subpart must be shown for each critical loading condition. Structural analysis (static or fatigue) may be used only if the structure conforms to those, for which experience has shown this method to be reliable. In other cases, substantiating load tests must be made.

(b) Proof of compliance with the strength requirements of this subpart must include—

(1) Dynamic and endurance tests of rotors, rotor drives, and rotor controls;

(2) Limit load tests of the control system, including control surfaces;

(3) Operation tests of the control system;

(4) Flight stress measurement tests;

(5) Landing gear drop tests; and

(6) Any additional tests required for new or unusual design features.

§ 27.309 Design limitations.

The following values and limitations must be established to show compliance with the structural requirements of this subpart:

(a) The design maximum weight.

(b) The main rotor r.p.m. ranges, power on and power off.

(c) The maximum forward speeds for each main rotor r.p.m. within the ranges determined under paragraph (b) of this section.

(d) The maximum rearward and sideward flight speeds.

(e) The center of gravity limits corresponding to the limitations determined under paragraphs (b), (c), and (d) of this section.

(f) The rotational speed ratios between each powerplant and each connected rotating component.

(g) The positive and negative limit maneuvering load factors.

FLIGHT LOADS

[§ 27.321 General.

[(a) The flight load factor must be assumed to act normal to the longitudinal axis of the rotorcraft, and to be equal in magnitude and opposite in direction to the rotorcraft inertia load factor at the center of gravity.]

(b) Compliance with the flight load requirements of this subpart must be shown—

(1) At each weight from the design minimum weight to the design maximum weight; and

(2) With any practical distribution of disposable load within the operating limitations in the Rotorcraft Flight Manual.

§ 27.337 Limit maneuvering load factor.

The rotorcraft must be designed for—

(a) A positive limit maneuvering load factor of 3.5 and a negative limit maneuvering load factor of 1.0; or

(b) Any lesser positive limit maneuvering load factor not less than 2.0, and lesser negative limit maneuvering load factor not less than 0.5, whose probability of being exceeded is shown by analysis and flight test to be extremely remote.

§ 27.339 Resultant limit maneuvering loads.

The loads resulting from the application of limit maneuvering load factors are assumed to act at the center of each rotor hub [and at each auxiliary lifting surface,] and to act in directions, and with distributions of load among the rotors and auxiliary lifting surfaces, so as to represent each critical maneuvering condition, including power-on and power-off flight with the maximum design rotor tip speed ratio. The rotor tip speed ratio is the ratio of the rotorcraft flight velocity component in the plane of the rotor disc to the rotational tip speed of the rotor blades, and is expressed as follows:

$$\mu=\frac{V \cos a}{\Omega R}$$

where—

V=The airspeed along flight path (f.p.s.);

a=The angle between the projection, in the plane of symmetry, of the axis of no feathering and a line perpendicular to the flight path (radians, positive when axis is pointing aft);

Ω=The angular velocity of rotor (radians per second); and

R=The rotor radius (ft.).

§ 27.341 Gust loads.

The rotorcraft must be designed to withstand, at each critical airspeed including hovering, the loads resulting from a vertical gust of 30 feet per second.

§ 27.361 Engine torque.

The limit engine torque may not be less than the mean torque multiplied by a factor of—

(a) 1.25, for turbine engines;

(b) 1.33, for engines with five or more cylinders; and

(c) 2.0, 3.0, and 4.0, for engines with four, three, and two cylinders, respectively.

CONTROL SURFACE AND SYSTEM LOADS

§ 27.391 General.

Each auxiliary rotor, each fixed or movable stabilizing or control surface, and each system operating any flight control must meet the requirements of §§ 27.395, 27.397, 27.401, 27.403, 27.411, and 27.413.

§ 27.395 Control system.

(a) The part of each control system from the pilot's controls to the control stops must be designed to withstand pilot forces of not less than—

(1) The forces specified in § 27.397; or

(2) If the system prevents the pilot from applying the limit pilot forces to the system, the maximum forces that the system allows the pilot to apply, but not less than 0.60 times the forces specified in § 27.397.

(b) The part of each control system from the control stops to the attachment to the rotor blades (or control areas) must be designed to at least—

(1) Withstand the maximum pilot forces obtainable in normal operation; and

(2) If operational loads may be exceeded through jamming, ground gusts, control inertia, or friction, support without yielding, 0.60 times the limit pilot forces specified in § 27.397.

[§ 27.397 Limit pilot forces and torques.

[(a) Except as provided in paragraph (b) of this section, the limit pilot forces are as follows:

[(1) For foot controls, 130 pounds.

[(2) For stick controls, 100 pounds fore and aft, and 67 pounds laterally.

[(b) For flap, tab, stabilizer, rotor brake, and landing gear operating controls, the following apply (R=radius in inches):

[(1) Crank, wheel, and level controls, $\frac{[1+R]}{3} \times 50$ pounds, but not less than 50 pounds nor more than 100 pounds for hand operated controls or 130 pounds for foot operated controls, applied at any angle within 20 degrees of the plane of motion of the control.

[(2) Twist controls, 80R pounds.]

§ 27.399 Dual control system.

Each dual primary flight control system must be designed to withstand the loads that result when pilot forces of 0.75 times those obtained under § 27.395 are applied—

(a) In opposition; and

(b) In the same direction.

§ 27.401 Auxiliary rotor assemblies.

(a) *Auxiliary rotor assemblies.* Each auxiliary rotor asembly must be tested as prescribed in § 27.923.

(b) *Assemblies with detachable blades.* Each auxiliary rotor assembly with detachable blades must be designed to withstand the centrifugal loads resulting from the maximum design rotor r.p.m.

§ 27.403 Auxiliary rotor attachment structure.

The attachment structure for each auxiliary rotor must be designed to withstand a limit load equal to the maximum loads occurring in the structure in any flight and landing condition.

§ 27.411 Ground clearance: tail rotor guard.

(a) It must be impossible for the tail rotor to contact the landing surface during a normal landing.

(b) If a tail rotor guard is required to show compliance with paragraph (a) of this section—

(1) Suitable design loads must be established for the guard; and

(2) The guard and its supporting structure must be designed to withstand those loads.

§ 27.413 Stabilizing and control surfaces.

(a) Each stabilizing and control surface must be designed so that—

(1) Limit loads are not less than the greater of—

(i) 15 pounds per square foot; or

(ii) The load resulting where C_N equals 0.55 at the maximum design speed; and

(2) The surface can withstand the critical loads resulting from maneuvers and from combined maneuvers and gusts.

(b) Compliance with paragraph (a) of this section must be shown with load distributions that closely simulate actual pressure distribution conditions.

GROUND LOADS

§ 27.471 General.

(a) *Loads and equilibrium.* For limit ground loads—

(1) The limit ground loads obtained in the landing conditions in this Part must be considered to be external loads that would occur in the rotorcraft structure if it were acting as a rigid body; and

(2) In each specified landing condition, the external loads must be placed in equilibrium with linear and angular inertia loads in a rational or conservative manner.

(b) *Critical centers of gravtity.* The critical centers of gravity within the range for which certification is requested must be selected so that the maximum design loads are obtained in each landing gear element.

§ 27.473 Ground loading conditions and assumptions.

(a) For specified landing conditions, a design maximum weight must be used that is not less than the maximum weight. A rotor lift may be assumed to act through the center of gravity throughout the landing impact. This lift may not exceed two-thirds of the design maximum weight.

(b) Unless otherwise prescribed, for each specified landing condition, the rotorcraft must be designed for a limit load factor of not less than the limit inertia load factor substantiated under § 27.725.

§ 27.475 Tires and shock absorbers.

Unless otherwise prescribed, for each specified landing condition, the tires must be assumed to be in their static position and the shock absorbers to be in their most critical position.

§ 27.477 Landing gear arrangement.

Sections 27.235, 27.479 through 27.485, and 27.493 apply to landing gear with two wheels aft, and one or more wheels forward, of the center of gravity.

§ 27.479 Level landing conditions.

(a) *Attitudes.* Under each of the loading conditions prescribed in paragraph (b) of this section, the rotorcraft is assumed to be in each of the following level landing attitudes:

(1) An attitude in which all wheels contact the ground simultaneously.

(2) An attitude in which the aft wheels contact the ground with the forward wheels just clear of the ground.

(b) *Loading conditions.* The rotorcraft must be designed for the following landing loading conditions:

(1) Vertical loads applied under § 27.471.

(2) The loads resulting from a combination of the loads spplied under subparagraph (1) of this paragraph with drag loads at each wheel of not less than 25 percent of the vertical load at that wheel.

(3) If there are two wheels forward, a distribution of the loads applied to those wheels under subparagraphs (1) and (2) of this paragraph in a ratio of 40:60.

(c) *Pitching moments.* Pitching moments are assumed to be resisted by—

(1) In the case of the attitude in paragraph (a)(1) of this section, the forward landing gear; and

(2) In the case of the attitude in paragraph (a)(2) of this section, the angular inertia forces.

§ 27.481 Tail-down landing conditions.

(a) The rotorcraft is assumed to be in the maximum nose-up attitude allowing ground clearance by each part of the rotorcraft.

(b) In this attitude, ground loads are assumed to act perpendicular to the ground.

§ 27.483 One-wheel landing conditions.

For the one-wheel landing condition, the rotorcraft is assumed to be in the level attitude and to contact the ground on one aft wheel. In this attitude—

(a) The vertical load must be the same as that obtained on that side under § 27.479(b)(1); and

(b) The unbalanced external loads must be reacted by rotorcraft inertia.

§ 27.485 Lateral drift landing conditions.

(a) The rotorcraft is assumed to be in the level landing attitude, with—

(1) Side loads combined with one-half of the maximum ground reactions obtained in the level landing conditions of § 27.479(b)(1); and

(2) The loads obtained under subparagraph (1) of this paragraph applied—

(i) At the ground contact point; or

(ii) For full-swiveling gear, at the center of the axle.

(b) The rotorcraft must be designed to withstand, at ground contact—

(1) When only the aft wheels contact the ground, side loads of 0.8 times the vertical reaction acting inward on one side, and 0.6 times the vertical reaction acting outward on the other side, all combined with the vertical loads specified in paragraph (a); and

(2) When all wheels contact the ground simultaneously—

(i) For the aft wheels, the side loads specified in subparagraph (1) of this paragraph; and

(ii) For the forward wheels, a side load of 0.8 times the vertical reaction combined with the vertical load specified in paragraph (a) of this section.

§ 27.493 Braked roll conditions.

Under braked roll conditions with the shock absorbers in their static positions—

(a) The limit vertical load must be based on a load factor of at least—

(1) 1.33, for the attitude specified in § 27.479(a)(1); and

(2) 1.0, for the attitude specified in § 27.479(a)(2); and

(b) The structure must be designed to withstand, at the ground contact point of each wheel with brakes, a drag load at least the lesser of—

(1) The vertical load multiplied by a coefficient of friction of 0.8; and

(2) The maximum value based on limiting brake torque.

§ 27.497 Ground loading conditions: landing gear with tail wheels.

(a) *General.* Rotorcraft with landing gear with two wheels forward, and one wheel aft, of the center of gravity must be designed for loading conditions as prescribed in this section.

(b) *Level landing attitude with only the forward wheels contacting the ground.* In this attitude—

(1) The vertical loads must be applied under §§ 27.471 through 27.475;

(2) The vertical load at each axle must be combined with a drag load at that axle of not less than 25 percent of that vertical load; and

(3) Unbalanced pitching moments are assumed to be resisted by angular inertia forces.

(c) *Level landing attitude with all wheels contacting the ground simultaneously.* In this attitude, the rotorcraft must be designed for landing loading conditions as prescribed in paragraph (b) of this section.

(d) *Maximum nose-up attitude with only the rear wheel contacting the ground.* The attitude for this condition must be the maximum nose-up attitude expected in normal operation, including autorotative landings. In this attitude—

(1) The appropriate ground loads specified in paragraph (b)(1) and (2) of this section must be determined and applied, using a rational method to account for the moment arm between the rear wheel ground reaction and the rotorcraft center of gravity; or

(2) The probability of landing with initial contact on the rear wheel must be shown to be extremely remote.

(e) *Level landing attitude with only one forward wheel contacting the ground.* In this attitude, the rotorcraft must be designed for ground loads as specified in paragraph (b)(1) and (3) of this section.

(f) *Side loads in the level landing attitude.* In the attitudes specified in paragraphs (b) and (c) of this section, the following apply:

(1) The side loads must be combined at each wheel with one-half of the maximum vertical ground reactions obtained for that wheel under paragraphs (b) and (c) of this section. In this condition, the side loads must be—

(i) For the forward wheels, 0.8 times the vertical reaction (on one side) acting inward, and 0.6 times the vertical reaction (on the other side) acting outward; and

(ii) For the rear wheel, 0.8 times the vertical reaction.

(2) The loads specified in subparagraph (1) of this paragraph must be applied—

(i) At the ground contact point with the wheel in the trailing position (for non-full swiveling landing gear or for full swiveling landing gear with a lock, steering device, or shimmy damper to keep the wheel in the trailing position); or

(ii) At the center of the axle (for full swiveling landing gear without a lock, steering device, or shimmy damper).

(g) *Braked roll conditions in the level landing attitude.* In the attitudes specified in paragraphs (b) and (c) of this section, and with the shock absorbers in their static positions, the rotorcraft must be designed for braked roll loads as follows:

(1) The limit vertical load must be based on a limit vertical load factor of not less than—

(i) 1.0, for the attitude specified in paragraph (b) of this section; and

(ii) 1.33, for the attitude specified in paragraph (c) of this section.

(2) For each wheel with brakes, a drag load must be applied, at the ground contact point, of not less than the lesser of—

(i) 0.8 times the vertical load; and

(ii) The maximum based on limiting brake torque.

(h) *Rear wheel turning loads in the static ground attitude.* In the static round attitude, and with the shock absorbers and tires in their static positions, the rotorcraft must be designed for rear wheel turning loads as follows:

(1) A vertical ground reaction equal to the static load on the rear wheel must be combined with an equal sideload.

(2) The load specified in subparagraph (1) of this paragraph must be applied to the rear landing gear—

(i) Through the axle, if there is a swivel (the rear wheel being assumed to be swiveled 90 degrees to the longitudinal axis of the rotorcraft); or

(ii) At the ground contact point, if there is a lock, steering device or shimmy damper (the rear wheel being assumed to be in the trailing position).

(i) *Taxiing condition.* The rotorcraft and its landing gear must be designed for loads that would occur when the rotorcraft is taxied over the roughest ground that may reasonably be expected in normal operation.

§ 27.501 Ground loading conditions; landing gear with skids.

(a) *General.* Rotorcraft with landing gear with skids must be designed for the loading conditions specified in this section. In showing compliance with this section, the following apply:

(1) The design maximum weight, center of gravity, and load factor must be determined under §§ 27.471 through 27.475.

(2) Structural yielding of elastic spring members under limit loads is acceptable.

(3) Design ultimate loads for elastic spring members need not exceed those obtained in a drop test of the gear with—

(i) A drop height of 1.5 times that specified in § 27.752; and

(ii) An assumed rotor lift of not more than 1.5 times that used in the limit drop tests prescribed in § 27.725.

(4) Compliance with paragraphs (b) through (e) of this section must be shown with—

(i) The gear in its most critically deflected position for the landing condition being considered; and

(ii) The ground reactions rationally distributed along the bottom of the skid tube.

(b) *Vertical reactions in the level landing attitude.* In the level attitude, and with the rotorcraft contacting the ground along the bottom of both skids, the vertical reactions must be applied as prescribed in paragraph (a) of this section.

(c) *Drag reactions in the level landing attitude.* In the level attitude, and with the rotorcraft contacting the ground along the bottom of both skids, the following apply:

(1) The vertical reactions must be combined with horizontal drag reactions of 50 percent of the vertical reaction applied at the ground.

(2) The resultant ground loads must equal the vertical load specified in paragraph (b) of this section.

(d) *Sideloads in the level landing attitude.* In the level attitude, and with the rotorcraft contacting the ground along the bottom of both skids, the following apply:

(1) The vertical ground reaction must be—

(i) Equal to the vertical loads obtained in the condition specified in paragraph (b) of this section; and

(ii) Divided equally among the skids.

(2) The vertical ground reactions must be combined with a horizontal sideload of 25 percent of their value.

(3) The total sideload must be applied along the length of one skid only.

(4) The unbalanced moments are assumed to be resisted by angular inertia.

(5) The skid gear must be investigated for—

(i) Inward acting sideloads; and

(ii) Outward acting sideloads.

(e) *One-skid landing loads in the level attitude.* In the level attitude, and with the rotorcraft contacting the ground along the bottom of one skid only, the following apply:

(1) The vertical load on the ground contact side must be the same as that obtained on that side in the condition specified in paragraph (b) of this section.

(2) The unbalanced moments are assumed to be resisted by angular inertia.

(f) *Special conditions.* In addition to the conditions specified in pargaraphs (b) and (c) of this section, the rotorcraft must be designed for the following ground reactions:

(1) A ground reaction load acting up and aft at an angle of 45° to the longitudinal axis of the rotorcraft. This load must be—

(i) Equal to 1.33 times the maximum weight;

(ii) Distributed symmetrically among the skids;

(iii) Concentrated at the forward end of the straight part of the skid tube; and

(iv) Applied only to the forward end of the skid tube and its attachment to the rotorcraft.

(2) With the rotorcraft in the level landing attitude, a vertical ground reaction load equal to one-half of the vertical load determined under paragraph (b) of this section. This load must be—

(i) Applied only to the skid tube and its attachment to the rotorcraft; and

(ii) Concentrated at a point midway between the skid tube attachments.

§ 27.505 Ski landing conditions.

If certification for ski operation is requested, the rotorcraft, with skis, must be designed to withstand the following loading conditions (where P is the maximum static weight on each ski with the rotorcraft at design maximum weight, and n is the limit load factor determined under § 27.473(b).

(a) Up-load conditions in which—

(1) A vertical load of Pn and a horizontal load of $Pn/4$ are simultaneously applied at the pedestal bearings; and

(2) A vertical load of 1.33 P is applied at the pedestal bearings.

(b) A side-load condition in which a side load of 0.35 Pn is applied at the pedestal bearings in a horizontal plane perpendicular to the centerline of the rotorcraft.

(c) A torque-load condition in which a torque of 1.33 P (in foot pounds) is applied to the ski about the vertical axis through the centerline of the pedestal bearings.

WATER LOADS

§ 27.521 Float landing conditions.

If certification for float operation is requested, the rotorcraft, with floats, must be designed to withstand the following loading conditions (where the limit load factor is determined under § 27.473(b) or assumed to be equal to that determined for wheel landing gear):

(a) Up-load conditions in which—

(1) A load is applied so that, with the rotorcraft in the static level attitude, the resultant water reaction passes vertically through the center of gravity; and

(2) The vertical load prescribed in subparagraph (1) of this paragraph is applied simultaneously with an aft component of 0.25 times the vertical component.

(b) A side-load condition in which—

(1) A vertical load of 0.75 times the total vertical load specified in paragraph (a) (1) of this section is divided equally among the floats; and

(2) For each float, the load share determined under subparagraph (1) of this paragraph, combined with a total side load of 0.25 times the total vertical load specified in subparagraph (1) of this paragraph, is applied to that float only.

MAIN COMPONENT REQUIREMENT

§ 27.547 Main rotor structure.

(a) Each main rotor assembly (including rotor hubs and blades) must be designed as prescribed in this section.

(b) [Reserved]

(c) The main rotor structure must be designed to withstand the following loads prescribed in § § 27.337 through 27.341:

(1) Critical flight loads.

(2) Limit loads occurring under normal conditions of autorotation. For this condition, the rotor r.p.m. must be selected to include the effects of altitude.

(d) The main rotor structure must be designed to withstand loads simulating—

(1) For the rotor blades, hubs, and flapping hinges, the impact force of each blade against its stop during ground operation; and

(2) Any other critical condition expected in normal operation.

(e) The main rotor structure must be designed to withstand the limit torque at any rotational speed, including zero. In addition:

(1) The limit torque need not be greater than the torque defined by a torque limiting device (where provided), and may not be less than the greater of—

(i) The maximum torque likely to be transmitted to the rotor structure in either direction; and

(ii) The limit engine torque specified in § 27.361.

(2) The limit torque must be distributed to the rotor blades in a rational manner.

§ 27.549 Fuselage, landing gear, and rotor pylon structures.

(a) Each fuselage, landing gear, and rotor pylon structure must be designed as prescribed in this section. Resultant rotor forces may be represented as a single force applied at the rotor hub attachment point.

(b) Each structure must be designed to withstand—

(1) The critical loads prescribed in § § 27.337 through 27.341;

(2) The applicable ground loads prescribed in § § 27.235, 27.471 through 27.485, 27.493, 27.497, 27.501, 27.505, and 27.521; and

(3) The loads prescribed in § 27.547 (d)(2) and (e).

(c) Auxiliary rotor thrust, and the balancing air and inertia loads occurring under accelerated flight conditions, must be considered.

(d) Each engine mount and adjacent fuselage structure must be designed to withstand the loads occurring under accelerated flight and landing conditions, including engine torque.

EMERGENCY LANDING CONDITIONS

§ 27.561 General.

(a) The rotorcraft, although it may be damaged in emergency landing conditions on land or water, must be designed as prescribed in this section to protect the occupants under those conditions.

(b) The structure must be designed to give each occupant every reasonable chance of escaping serious injury in a minor crash landing when—

(1) Proper use is made of seats, belts, and other safety design provisions;

(2) The wheels are retracted (where applicable); and

(3) The occupant experiences the following ultimate inertia forces relative to the surrounding structure:

(i) Upward—1.5 *g*.

(ii) Forward—4.0 *g*.

(iii) Sideward—2.0 *g*.

(iv) Downward—4.0 *g*, or any lower force that will not be exceeded when the rotorcraft absorbs the landing loads resulting from impact with an ultimate descent velocity of five f.p.s. at design maximum weight.

(c) The supporting structure must be designed to restrain, under any load up to those specified in paragraph (b)(3) of this section, any item of mass that could injure an occupant if it came loose in a minor crash landing.

§ 27.563 Structural ditching provisions.

Structural strength considerations of ditching must be in accordance with § 27.801(e).

FATIGUE EVALUATION

§ 27.571 Fatigue evaluation of flight structure.

(a) *General.* Each portion of the flight structure (the flight structure includes rotors, rotor drive systems between the engines and the rotor hubs, controls, fuselage, and their related primary attachments) the failure of which could be catastrophic, must be identified and must be evaluated under paragraph (b), (c), (d) or (e) of this section. The following apply to each fatigue evaluation:

(1) The procedure for the evaluation must be approved.

(2) The locations of probable failure must be determined.

(3) Inflight measurement must be included in determining the following:

(i) Loads or stresses in all critical conditions throughout the range of limitations in § 27.309, except that maneuvering load factors need not exceed the maximum values expected in operation.

(ii) The effect of altitude upon these loads or stresses.

(4) The loading spectra must be as severe as those expected in operation and must be based on loads or stresses determined under subparagraph (3) of this paragraph.

(b) *Fatigue tolerance evaluation.* It must be shown that the fatigue tolerance of the structure ensures that the probability of catastrophic fatigue failure is extremely remote without establishing replacement times, inspection intervals or other procedures under [§ A27.4 of Appendix A.]

(c) *Replacement time evaluation.* It must be shown that the probability of catastrophic fatigue failure is extremely remote within a replacement time furnished under [§ A27.4 of Appendix A.]

(d) *Failsafe evaluation.* The following apply to failsafe evaluations:

(1) It must be shown that all partial failures will become readily detectable under inspection procedures furnished under [A27.4 of Appendix A.]

(2) The interval between the time when any partial failure becomes readily detectable under subparagraph (1), and the time when any such failure is expected to reduce the remaining strength of the structure to limit or maximum attainable loads (whichever is less), must be determined.

(3) It must be shown that the interval determined under subparagraph (2) is long enough, in relation to the inspection intervals and related procedures furnished under [A27.4 of Appendix A,] to provide a probability of detection great enough to ensure that the probability of catastrophic failure is extremely remote.

(e) *Combination of replacement time and failsafe evaluations.* A component may be evaluated under a combination of paragraphs (c) and (d) of this section. For such component, it must be shown that the probability of catastrophic failure is extremely remote with an approved combination of replacement time, inspection intervals, and related procedures furnished under [A27.4 of Appendix A.]

Subpart D—Design and Construction

GENERAL

§ 27.601 Design.

(a) The rotorcraft may have no design features or details that experience has shown to be hazardous or unreliable.

(b) The suitability of each questionable design detail and part must be established by tests.

§ 27.603 Materials.

The suitability and durability of materials used for parts, the failure of which could adversely affect safety, must—

(a) Be established on the basis of experience or tests:

(b) Meet approved specifications that ensure their having the strength and other properties assumed in the design data; and

(c) Take into account the effects of environmental conditions, such as temperature and humidity, expected in service.

§ 27.605 Fabrication methods.

(a) The methods of fabrication used must produce consistently sound structures. If a fabrication process (such as gluing, spot welding, or heat-treating) requires close control to reach this objective, the process must be performed according to an approved process specification.

(b) Each new aircraft fabrication method must be substantiated by a test program.

§ 27.607 Fasteners.

(a) Each removable bolt, screw, nut, pin, or other fastener whose loss could jeopardize the safe operation of the rotorcraft must incorporate two separate locking devices. The fastener and its locking devices may not be adversely affected by the environmental conditions associated with the particular installation.

(b) No self-locking nut may be used on any bolt subject to rotation in operation unless a nonfriction locking device is used in addition to the self-locking device.

§ 27.609 Protection of structure.

Each part of the structure must—

(a) Be suitably protected against deterioration or loss of strength in service due to any cause, including—

(1) Weathering;

(2) Corrosion; and

(3) Abrasion; and

(b) Have provisions for ventilation and drainage where necessary to prevent the accumulation of corrosive, flammable, or noxious fluids.

[§ 27.610 Lightning protection.

[(a) The rotorcraft must be protected against catastrophic effects from lightning.

[(b) For metallic components, compliance with paragraph (a) of this section may be shown by—

[(1) Electrically bonding the components properly to the airframe; or

[(2) Designing the components so that a strike will not endanger the rotorcraft.

[(c) For nonmetallic components, compliance with paragraph (a) of this section may be shown by—

[(1) Designing the components to minimize the effect of a strike; or

[(2) Incorporating acceptable means of diverting the resulting electrical current so as not to endanger the rotorcraft.]

§ 27.611 Inspection provisions.

There must be means to allow the close examination of each part that requires—

(a) Recurring inspection;

(b) Adjustment for proper alignment and functioning; or

(c) Lubrication.

§ 27.613 Material strength properties and design values.

(a) Material strength properties must be based on enough tests of material meeting specifications to establish design values on a statistical basis.

(b) Design values must be chosen so that the probability of any structure being understrength because of material variations is extremely remote.

(c) The strength, detail design, and fabrication of the structure must minimize the probability of disastrous fatigue failure, particularly at points of stress concentration.

(d) Design values must be those contained in the following publications (available from the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402) or other values approved by the Administrator:

(1) MIL-HDBK-5, "Metallic Materials and Elements for Flight Vehicle Structure".

(2) MIL-HDBK-17, "Plastics for Flight Vehicles".

(3) ANC-18, "Design of Wood Aircraft Structures".

(4) MIL-HDBK-23, "Composite Construction for Flight Vehicles".

§ 27.619 Special factors.

(a) The special factors prescribed in §§ 27.621 through 27.625 apply to each part of the structure whose strength is—

(1) Uncertain;

(2) Likely to deteriorate in service before normal replacement; or

(3) Subject to appreciable variability due to—

(i) Uncertainties in manufacturing processes; or

(ii) Uncertainties in inspection methods.

(b) For each part to which §§ 27.621 through 27.625 apply, the factor of safety prescribed in § 27.303 must be multiplied by a special factor equal to—

(1) The applicable special factors prescribed in §§ 27.621 through 27.625; or

(2) Any other factor great enough to ensure that the probability of the part being understrength because of the uncertainties specified in paragraph (a) of this section is extremely remote.

§ 27.621 Casting factors.

(a) *General.* The factors, tests, and inspections specified in paragraphs (b) and (c) of this section must be applied in addition to those necessary to establish foundry quality control. The inspections must meet approved specifications. Paragraphs (c) and (d) of this section apply to structural castings except castings that are pressure tested as parts of hydraulic or other fluid systems and do not support structural loads.

(b) *Bearing stresses and surfaces.* The casting factors specified in paragraphs (c) and (d) of this section—

(1) Need not exceed 1.25 with respect to bearing stresses regardless of the method of inspection used; and

(2) Need not be used with respect to the bearing surfaces of a part whose bearing factor is larger than the applicable casting factor.

(c) *Critical castings.* For each casting whose failure would preclude continued safe flight and landing of the rotorcraft or result in serious injury to any occupant, the following apply:

(1) Each critical casting must—

(i) Have a casting factor of not less than 1.25; and

(ii) Receive 100 percent inspection by visual, radiographic, and magnetic particle (for ferromagnetic materials) or penetrate (for nonferromagnetic materials) inspection methods or approved equivalent inspection methods.

(2) For each critical casting with a casting factor less than 1.50, three sample castings must be static tested and shown to meet—

(i) The strength requirements of § 27.305 at an ultimate load corresponding to a casting factor at 1.25; and

(ii) The deformation requirements of § 27.305 at a load of 1.15 time the limit load.

(d) *Noncritical castings.* For each casting other than those specified in paragraph (c) of this section, the following apply:

(1) Except as provided in subparagraphs (2) and (3) of this paragraph, the casting factors and corresponding inspections must meet the following table:

Casting factor	*Inspection*
2.0 or greater	100 percent visual.
Less than 2.0, greater than 1.5.	100 percent visual, and magnetic particle (ferromagnetic materials), penetrant (nonferromagnetic materials), or approved equivalent inspection methods.
1.25 through 1.50.	100 percent visual, and magnetic particle (ferromagnetic materials), penetrant (nonferromagnetic materials), and radiographic or approved equivalent inspection methods.

(2) The percentage of castings inspected by nonvisual methods may be reduced below that specified in subparagraph (1) of this paragraph when an approved quality control procedure is established.

(3) For castings procured to a specification that guarantees the mechanical properties of the material in the casting and provides for demonstration of these properties by test of coupons cut from the castings on a sampling basis—

(i) A casting factor of 1.0 may be used; and

(ii) The castings must be inspected as provided in subparagraph (1) of this paragraph for casting factors of "1.25 through 1.50" and tested under paragraph (c) (2) of this section.

§ 27.623. Bearing factors.

(a) Except as provided in paragraph (b) of this section, each part that has clearance (free fit), and that is subject to pounding or vibration, must have a bearing factor large enough to provide for the effects of normal relative motion.

(b) No bearing factor need be used on a part for which any larger special factor is prescribed.

§ 27.625 Fitting factors.

For each fitting (part or terminal used to join one structural member to another) the following apply:

(a) For each fitting whose strength is not proven by limit and ultimate load tests in which actual stress conditions are simulated in the fitting and surrounding structures, a fitting factor of at least 1.15 must be applied to each part of—

(1) The fitting;

(2) The means of attachment; and

(3) The bearing on the joined members.

(b) No fitting factor need be used—

(1) For joints made under approved practices and based on comprehensive test data (such as continuous joints in metal plating, welded joints, and scarf joints in wood); and

(2) With respect to any bearing surface for which a larger special factor is used.

(c) For each integral fitting, the part must be treated as a fitting up to the point at which the section properties become typical of the member.

§ 27.629 Flutter.

Each part of the rotorcraft must be free from flutter under each appropriate speed and power condition.

ROTORS

§ 27.653 Pressure venting and drainage of rotor blades.

(a) For each rotor blade—

(1) There must be means for venting the internal pressure of the blade;

(2) Drainage holes must be provided for the blade; and

(3) The blade must be designed to prevent water from becoming trapped in it.

(b) Paragraphs (a) (1) and (2) of this section do not apply to sealed rotor blades capable of withstanding the maximum pressure differentials expected in service.

§ 27.659 Mass balance.

(a) The rotors and blades must be mass balanced as necessary to—

(1) Prevent excessive vibration; and

(2) Prevent flutter at any speed up to the maximum forward speed.

(b) The structural integrity of the mass balance installation must be substantiated.

§ 27.661 Rotor blade clearance.

There must be enough clearance between the rotor blades and other parts of the structure to prevent the blades from striking any part of the structure during any operating condition.

§ 27.663 Ground resonance prevention means.

(a) The reliability of the means for preventing ground resonance must be shown either by analysis and tests, or reliable service experience, or by showing that malfunction of a single means will not cause ground resonance.

(b) The probable range of variations, during service, of the damping action of the ground resonance prevention means must be established and must be investigated during the test required by § 27.241.

CONTROL SYSTEMS

§ 27.671 General.

(a) Each control and control system must operate with the ease, smoothness, and positiveness appropriate to its function.

(b) Each element of each flight control system must be designed, or distinctively and permanently marked, to minimize the probability of any incorrect assembly that could result in the malfunction of the system.

[§ 27.672 Stability augmentation, automatic, and power-operated systems.

[If the functioning of stability augmentation or other automatic or power-operated systems is necessary to show compliance with the flight characteristics requirements of this Part, such systems must comply with § 27.671 of this Part and the following:

[(a) A warning which is clearly distinguishable to the pilot under expected flight conditions without requiring the pilot's attention must be provided for any failure in the stability augmentation system or in any other automatic or power-operated system which could result in an unsafe condition if the pilot is unaware of the failure. Warning systems must not activate the control systems.

[(b) The design of the stability augmentation system or of any other automatic or power-operated system must allow initial counteraction of failures without requiring exceptional pilot skill or strength by overriding the failure by movement of the flight controls in the normal sense and deactivating the failed system.

[(c) It must be shown that after any single failure of the stability augmentation system or any other automatic or power-operated system—

[(1) The rotorcraft is safely controllable when the failure or malfunction occurs at any speed or altitude within the approved operating limitations;

[(2) The controllability and maneuverability requirements of this Part are met within a practical operational flight envelope (for example, speed, altitude, normal acceleration, and rotorcraft configurations) which is described in the Rotorcraft Flight Manual; and

[(3) The trim and stability characteristics are not impaired below a level needed to permit continued safe flight and landing.

[§ 27.673. Primary flight control.

[Primary flight controls are those used by the pilot for immediate control of pitch, roll, yaw, and vertical motion of the rotorcraft.]

§ 27.675 Stops.

(a) Each control system must have stops that positively limit the range of motion of the pilot's controls.

(b) Each stop must be located in the system so that the range of travel of its control is not appreciably affected by—

(1) Wear;

(2) Slackness; or

(3) Takeup adjustments.

(c) Each stop must be able to withstand the loads corresponding to the design conditions for the system.

(d) For each main rotor blade—

(1) Stops that are appropriate to the blade design must be provided to limit travel of the blade about its hinge points; and

(2) There must be means to keep the blade from hitting the droop stops during any operation other than starting and stopping the rotor.

§ 27.679 Control system locks.

If there is a device to lock the control system with the rotorcraft on the ground or water, there must be means to—

(a) Give unmistakable warning to the pilot when the lock is engaged; and

(b) Prevent the lock from engaging in flight.

§ 27.681 Limit load static tests.

(a) Compliance with the limit load requirements of this Part must be shown by tests in which—

(1) The direction of the test loads produces the most severe loading in the control system; and

(2) Each fitting, pulley, and bracket used in attaching the system to the main structure is included.

(b) Compliance must be shown (by analyses or individual load tests) with the special factor requirements for control system joints subject to angular motion.

§ 27.683 Operation tests.

It must be shown by operation tests that, when the controls are operated from the pilot compartment with the control system loaded to correspond with loads specified for the system, the system is free from—

(a) Jamming;

(b) Excessive friction; and

(c) Excessive deflection.

§ 27.685 Control system details.

(a) Each detail of each control system must be designed to prevent jamming, chafing, and interference from cargo, passengers, loose objects, or the freezing of moisture.

(b) There must be means in the cockpit to prevent the entry of foreign objects into places where they would jam the system.

(c) There must be means to prevent the slapping of cables or tubes against other parts.

§ 27.687 Spring devices.

(a) Each control system spring device where failure could cause flutter or other unsafe characteristics must be reliable.

(b) Compliance with paragraph (a) of this section must be shown by tests simulating service conditions.

§ 27.691 Autorotation control mechanism.

Each main rotor blade pitch control mechanism must allow rapid entry into autorotation after power failure.

§ 27.695 Power boost and power-operated control system.

(a) If a power boost or power-operated control system is used, an alternate system must be immediately available that allows continued safe flight and landing in the event of—

(1) Any single failure in the power portion of the system; or

(2) The failure of all engines.

(b) Each alternate system may be a duplicate power portion or a manually operated mechanical system. The power portion includes the power source (such as hydraulic pumps), and such items as valves, lines, and actuators.

(c) The failure of mechanical parts (such as piston rods and links), and the jamming of power cylinders, must be considered unless they are extremely improbable.

LANDING GEAR

§ 27.723 Shock absorption tests.

The landing inertia load factor and the reserve energy absorption capacity of the landing gear must be substantiated by the tests prescribed in §§ 27.725 and 27.727, respectively. These tests must be conducted on the complete rotorcraft or on units consisting of wheel, tire, and shock absorber in their proper relation.

§ 27.725 Limit drop test.

The limit drop test must be conducted as follows:

(a) The drop height must be—

(1) 13 inches from the lowest point of the landing gear to the ground; or

(2) Any lesser height, not less than eight inches, resulting in a drop contact velocity equal to the greatest probable sinking speed likely to occur at ground contact in normal power-off landings.

(b) If considered, the rotor life specified in § 27.473(a) must be introduced into the drop test by appropriate energy absorbing devices or by the use of an effective mass.

(c) Each landing gear unit must be tested in the attitude simulating the landing condition that is most critical from the standpoint of the energy to be absorbed by it.

(d) When an effective mass is used in showing compliance with paragraph (b) of this section, the following formula may be used instead of more rational computations:

$$W_e = W\left[\frac{h+(1-L)d}{h+d}\right]; \text{ and } n = n_j \frac{W_e}{W} + L$$

where:

W_e = the effective weight to be used in the drop test (lbs.);

$W = W_M$ for main gear units (lbs.), equal to the static reaction on the particular unit with the rotorcraft in the most critical attitude. A rational method may be used in computing a main gear static reaction, taking into consideration the moment arm between the main wheel reaction and the rotorcraft center of gravity.

$W = W_N$ for nose gear units (lbs.), equal to the vertical component of the static reaction that would exist at the nose wheel, assuming that the mass of the rotorcraft acts at the center of gravity and exerts a force of 1.0*g* downward and 0.25*g* forward.

$W = W_T$ for tailwheel units (lbs.), equal to whichever of the following is critical:

(1) The static weight on the tailwheel with the rotorcraft resting on all wheels; or

(2) The vertical component of the ground reaction that would occur at the tailwheel, assuming that the mass of the rotorcraft acts at the center of gravity and exerts a force of 1*g* downward with the rotorcraft in the maximum nose-up attitude considered in the nose-up landing conditions.

h = specified free drop height (inches).

L = ratio of assumed rotor lift to the rotorcraft weight.

d = deflection under impact of the tire (at the proper inflation pressure) plus the vertical component of the axle travels (inches) relative to the drop mass.

n = limit inertia load factor.

n_j = the load factor developed, during impact, on the mass used in the drop test (i.e., the acceleration *dv/dt* in *g*'s recorded in the drop test plus 1.0).

§ 727.727 Reserve energy absorption drop test.

The reserve energy absorption drop test must be conducted as follows:

(a) The drop height must be 1.5 times that specified in § 27.725(a).

(b) Rotor lift, where considered in a manner similar to that prescribed in § 27.725(b), may not exceed 1.5 times the lift allowed under that paragraph.

(c) The landing gear must withstand this test without collapsing.

[§ 27.729 Retracting mechanism.

[For rotorcraft with retractable landing gear, the following apply:

[(a) *Loads.* The landing gear, retracting mechanism, wheel-well doors, and supporting structure must be designed for—

[(1) The loads occurring in any maneuvering condition with the gear retracted;

[(2) The combined friction, inertia, and air loads occurring during retraction and extension at any airspeed up to the design maximum landing gear operating speed; and

[(3) The flight loads, including those in yawed flight, occurring with the gear extended at any airspeed up to the design maximum landing gear extended speed.

[(b) *Landing gear lock.* A positive means must be provided to keep the gear extended.

[(c) *Emergency operation.* When other than manual power is used to operate the gear, emergency means must be provided for extending the gear in the event of—

[(1) Any reasonably probable failure in the normal retraction system; or

[(2) The failure of any single source of hydraulic, electric, or equivalent energy.

[(d) *Operation tests.* The proper functioning of the retracting mechanism must be shown by operation tests.

[(e) *Position indicator.* There must be a means to indicate to the pilot when the gear is secured in the extreme positions.

[(f) *Control.* The location and operation of the retraction control must meet the requirements of §§ 27.777 and 27.779.

[(g) *Landing gear warning.* An aural or equally effective landing gear warning device must be provided that functions continuously when the rotorcraft is in a normal landing mode and the landing gear is not fully extended and locked. A manual shutoff capability must be provided for the warning device and the warning system must automatically reset when the rotorcraft is no longer in the landing mode.]

§ 27.731 Wheels.

(a) Each landing gear wheel must be approved.

(b) The maximum static load rating of each wheel may not be less than the corresponding static ground reaction with—

(1) Maximum weight; and

(2) Critical center of gravity.

(c) The maximum limit load rating of each wheel must equal or exceed the maximum radial limit load determined under the applicable ground load requirements of this Part.

§ 27.733 Tires.

(a) Each landing gear wheel must have a tire—

(1) That is a proper fit on the rim of the wheel; and

(2) Of the proper rating.

(b) The maximum static load rating of each tire must equal or exceed the static ground reaction obtained at its wheel, assuming—

(1) The design maximum weight; and

(2) The most unfavorable center of gravity.

(c) Each tire installed on a retractable landing gear system must, at the maximum size of the tire type expected in service, have a clearance to surrounding structure and systems that is adequate to prevent contact between the tire and any part of the structure or systems.

§ 27.735 Brakes.

[For rotorcraft with wheel-type landing gear, a braking device must be installed that is—]

(a) Controllable by the pilot;

(b) Usable during power-off landings; and

(c) Adequate to—

(1) Counteract any normal unbalanced torque when starting or stopping the rotor; and

(2) Hold the rotorcraft parked on a 10° slope on a dry, smooth pavement.

§ 27.737 Skis.

The maximum limit load rating of each ski must equal or exceed the maximum limit load determined under the applicable ground load requirements of this Part.

FLOATS AND HULLS

§ 27.751 Main float bouyancy.

(a) For main floats, the buoyancy necessary to support the maximum weight of the rotorcraft in fresh water must be exceeded by—

(1) 50 percent, for single floats; and

(2) 60 percent, for multiple floats.

(b) Each main float must have enough watertight compartments so that, with any single main float compartment flooded, the main floats will provide a margin of positive stability great enough to minimize the probability of capsizing.

§ 27.753 Main float design.

(a) *Bag floats.* Each bag float must be designed to withstand—

(1) The maximum pressure differential that might be developed at the maximum altitude for which certification with that float is requested; and

(2) The vertical loads prescribed in § 27.521(a), distributed along the length of the bag over three-quarters of its projected area.

(b) *Rigid floats.* Each rigid float must be able to withstand the vertical, horizontal, and side loads prescribed in § 27.521. These loads may be distributed along the length of the float.

§ 27.755 Hulls.

For each rotorcraft, with a hull and auxiliary floats, that is to be approved for both taking off from and landing on water, the hull and auxiliary floats must have enough water-tight compartments so that, with any single compartment flooded, the buoyancy of the hull and auxiliary floats (and wheel tires if used) provides a margin of positive stability great enough to minimize the probability of capsizing.

PERSONNEL AND CARGO ACCOMMODATIONS

§ 27.771 Pilot compartment.

For each pilot compartment—

(a) The compartment and its equipment must allow each pilot to perform his duties without unreasonable concentration or fatigue;

(b) If there is provision for a second pilot, the rotorcraft must be controllable with equal safety from either pilot seat; and

(c) The vibration and noise characteristics of cockpit appurtenances may not interfere with safe operation.

§ 27.773 Pilot compartment view.

(a) Each pilot compartment must be free from glare and reflections that could interfere with the pilot's view, and designed so that—

(1) Each pilot's view is sufficiently extensive, clear, and undistorted for safe operation; and

(2) Each pilot is protected from the elements so that moderate rain conditions do not unduly impair his view of the flight path in normal flight and while landing.

(b) If certification for night operation is requested, compliance with paragraph (a) of this section must be shown in night flight tests.

§ 27.775 Windshields and windows.

Nonsplintering safety glass must be used in glass windshields and windows.

§ 27.777 Cockpit controls.

Cockpit controls must be—

(a) Located to provide convenient operation and to prevent confusion and inadvertent operation; and

(b) Located and arranged with respect to the pilots' seats so that there is full and unrestricted movement of each control without interference from the cockpit structure or the pilot's clothing when pilots from 5′2″ to 6′0″ in height are seated.

[§ 27.779 Motion and effect of cockpit controls.

[Cockpit controls must be designed so that they operate in accordance with the following movements and actuation:

[(a) Flight controls, including the collective pitch control, must operate with a sense of motion which corresponds to the effect on the rotorcraft.

[(b) Twist-grip engine power controls must be designed so that, for lefthand operation, the motion of the pilot's hand is clockwise to increase power when the hand is viewed from the edge containing the index finger. Other engine power controls, excluding the collective control, must operate with a forward motion to increase power.

[(c) Normal landing gear controls must operate downward to extend the landing gear.]

§ 27.783 Doors.

(a) Each closed cabin must have at least one adequate and easily accessible external door.

(b) No passenger door may be located with respect to any rotor disc so as to endanger persons using that door.

[§ 27.785 Seats, berths, safety belts, and harnesses.

[(a) Each seat, berth, safety belt, harness, and adjacent part of the rotorcraft, at each station designated for occupancy during takeoff and landing, must be free of potentially injurious objects, sharp edges, protuberances, and hard surfaces, and must be designed so that a person making proper use of these facilities will not suffer serious injury in an emergency landing as a result of the inertia forces specified in § 27.561.

[(b) Each occupant must be protected from head injury by—

[(1) For each crewmember seat and each seat beside a crewmember front seat, a safety belt and harness that will prevent the head from contacting any injurious object; and

[(2) For each seat not covered under paragraph (b) (1)—

[(i) A safety belt plus the absence of injurious objects within striking radius of the head;

[(ii) A safety belt plus a shoulder harness that will prevent the head from contacting any injurious object; or

[(iii) A safety belt plus an energy-absorbing rest that will support the arms, shoulders, head, and spine.

[(c) Each pilot's seat must have a combined safety belt and shoulder harness with a single-point release that permits the pilot, when seated with safety belt and shoulder harness fastened, to perform all of the pilot's necessary functions. There must be a means to secure belts and harnesses, when not in use, to prevent interference with this operation of the rotorcraft and with rapid egress in an emergency.

[(d) If seat backs do not have a firm handhold, there must be hand grips or rails along each aisle to enable the occupants to steady themselves while using the aisle in moderately rough air.

[(e) Each projecting object that could injure persons seated or moving about in the rotorcraft in normal flight must be padded.

[(f) Each seat and its supporting structure must be designed for an occupant weight of 170 pounds, considering the maximum load factors, inertia forces, and reactions between the occupant, seat, and safety belt or harness corresponding with the applicable flight and ground-load conditions, including the emergency landing conditions of § 27.561. In addition—

[(1) Each pilot seat must be designed for the reactions resulting from the application of the pilot forces prescribed in § 27.397; and

[(2) The inertia forces prescribed in § 27.561 must be multiplied by a factor of 1.33 in determining the strength of the attachment of—

[(i) Each seat to the structure; and

[(ii) Each safety belt or harness to the seat or structure.

[(g) When the safety belt and shoulder harness are combined, the rated strength of the safety belt and shoulder harness may not be less than that corresponding to the inertia forces specified in § 27.561, considering the occupant weight of at least 170 pounds, considering the dimensional characteristics of the restraint system installation, and using a distribution of at least 60 percent load to the safety belt and at least 60 percent load to the shoulder harness. If the safety belt is capable of being used without the shoulder harness, the inertia forces specified must be met by the safety belt alone.

[(h) When a headrest is used, the headrest and its supporting structure must be designed to resist the inertia forces specified in § 27.561, with a 1.33 fitting factor and a head weight of at least 13 pounds.]

§ 27.787 Cargo and baggage compartments.

(a) Each cargo and baggage compartment must be designed for its placarded maximum weight of contents and for the critical load distributions at the appropriate maximum load factors corresponding to the specified flight and ground load conditions, except the emergency landing conditions of § 27.561.

(b) There must be means to prevent the contents of any compartment from becoming a hazard by shifting under the loads specified in paragraph (a) of this section.

(c) There must be means to protect each occupant from injury by the contents of any compartment when the ultimate forward inertia force is 4*g*.

(d) If cargo compartment lamps are installed, each lamp must be installed so as to prevent contact between lamp bulb and cargo.

§ 27.801 Ditching.

(a) If certification with ditching provisions is requested, the rotorcraft must meet the requirements of this section and §§ 27.807(d), 27.1411 and 27.1415.

(b) Each practicable design measure, compatible with the general characteristics of the rotorcraft, must be taken to minimize the probability that in an emergency landing on water, the behavior of the rotorcraft would cause immediate injury to the occupants or would make it impossible for them to escape.

(c) The probable behavior of the rotorcraft in a water landing must be investigaged by model tests or by comparison with rotorcraft of similar configuration for which the ditching characteristics are known. Scoops, flaps, projections, and any other factor likely to affect the hydrodynamic characteristics of the rotorcraft must be considered.

(d) It must be shown that, under reasonably probable water conditions, the flotation time and trim of the rotorcraft will allow the occupants to leave the rotorcraft and enter the life rafts required by § 27.1415. If compliance with this provision is shown by buoyancy and trim computations, appropriate allowances must be made for probable structural damage and leakage. If the rotorcraft has fuel tanks (with fuel jettisoning provisions) that can reasonably be expected to withstand a ditching without leakage, the jettisonable volume of fuel may be considered as buoyancy volume.

(e) Unless the effects of the collapse of external doors and windows are accounted for in the investigation of the probable behavior of the rotorcraft in a water landing (as prescribed in paragraphs (c) and (d) of this section), the external doors and windows must be designed to withstand the probable maximum local pressures.

§ 27.807 Emergency exits.

[(a) *Number and location.* Rotorcraft with closed cabins must have at least one emergency exit on the opposite side of the cabin from the main door.]

(b) *Type and operation.* Each emergency exit prescribed in paragraph (a) of this section must—

(1) Consist of a movable window or panel, or additional external door, providing an unobstructed opening that will admit a 19- by 26-inch ellipse;

(2) Be readily accessible, require no exceptional agility of a person using it, and be located so as to allow ready use, without crowding, in any probable attitudes that may result from a crash;

(3) Have a simple and obvious method of opening and be arranged and marked so as to be readily located and operated, even in darkness; and

(4) Be reasonably protected from jamming by fuselage deformation.

(c) *Tests.* The proper functioning of each emergency exit must be shown by test.

(d) *Ditching emergency exits for passengers.* If certification with ditching provisions is requested, one emergency exit on each side of the fuselage must—

(1) Be above the waterline; and

(2) Have at least the dimension specified in paragraph (b) of this section.

§ 27.831 Ventilation.

(a) The ventilating system for the pilot and passenger compartments must be designed to prevent the presence of excessive quantities of fuel fumes and carbon monoxide.

(b) The concentration of carbon monoxide may not exceed one part in 20,000 parts of air during forward flight or hovering in still air. If the concentration exceeds this value under other conditions, there must be suitable operating restrictions.

FIRE PROTECTION

§ 27.853 Compartment interiors.

For each compartment to be used by the crew or passengers—

(a) The materials must be at least flash resistant;

(b) The wall and ceiling linings, and the covering of upholstery, floors, and furnishings must be at least flame resistant; and

(c) If smoking is to be prohibited, there must be a placard so stating, and if smoking is to be allowed—

(1) There must be an adequate number of self-contained, removable ashtrays; and

(2) Where the crew compartment is separated from the passenger compartment, there must be at least one illuminated sign (using either letters or symbols) notifying all passengers when smoking is prohibited. Signs which notify when smoking is prohibited must—

(i) When illuminated, be legible to each passenger seated in the passenger cabin under all probable lighting conditions; and

(ii) Be so constructed that the crew can turn the illumination on and off.

§ 27.855 Cargo and baggage compartments.

(a) Each cargo and baggage compartment must be constructed of, or lined with, materials that are at least—

(1) Flame resistant, in the case of compartments that are readily accessible to a crewmember in flight; and

(2) Fire resistant, in the case of other compartments.

(b) No compartment may contain any controls, wiring, lines, equipment, or accessories whose damage or failure would affect safe operation, unless those items are protected so that—

(1) They cannot be damaged by the movement of cargo in the compartment; and

(2) Their breakage or failure will not create a fire hazard.

§ 27.859 Heating systems.

(a) *General.* For each heating system that involves the passage of cabin air over, or close to, the exhaust manifold, there must be means to prevent carbon monoxide from entering any cabin or pilot compartment.

(b) *Heat exchangers.* Each heat exchanger must be—

(1) Of suitable materials;

(2) Adequately cooled under all conditions; and

(3) Easily disassembled for inspection.

(c) *Combustion heaters.* Each gasoline operated combustion heater must be approved and installed to meet the applicable powerplant installation requirements covering fire hazards and precautions. In addition—

(1) Each applicable requirement concerning fuel tanks, lines, and exhaust systems must be met; and

(2) Means independent of the components provided for the normal continuous control of air temperature, airflow, and fuel flow must be provided, for each heater, to automatically shut off and hold off the ignition and fuel supply of that heater at a point remote from that heater when any of the following occurs:

(i) The heat exchanger temperature exceeds safe limits.

(ii) The ventilating air temperature exceeds safe limits.

(iii) The combustion airflow becomes inadequate for safe operation.

(iv) The ventilating airflow becomes inadequate for safe operation.

§ 27.861 Fire protection of structure, controls, and other parts.

Each part of the structure, controls, and the rotor mechanism, and other parts essential to a controlled landing that would be affected by powerplant fires must be protected so that they can perform their essential functions for at least 5 minutes under any foreseeable powerplant fire condition.

§ 27.863 Flammable fluid fire protection.

(a) In each area where flammable fluids or vapors might escape by leakage of a fluid system, there must be means to minimize the probability of ignition of the fluids and vapors, and the resultant hazards if ignition does occur.

(b) Compliance with paragraph (a) of this section must be shown by analysis or tests, and the following factors must be considered:

(1) Possible sources and paths of fluid leakage, and means of detecting leakage.

(2) Flammability characteristics of fluids, including effects of any combustible or absorbing materials.

(3) Possible ignition sources, including electrical faults, overheating of equipment, and malfunctioning of protective devices.

(4) Means available for controlling or extinguishing a fire, such as stopping flow of fluids, shutting down equipment, fireproof containment, or use of extinguishing agents.

(5) Ability of rotorcraft components that are critical to safety of flight to withstand fire and heat.

(c) If action by the flight crew is required to prevent or counteract a fluid fire (e.g. equipment shutdown or actuation of a fire extinguisher) quick acting means must be provided to alert the crew.

(d) Each area where flammable fluids or vapors might escape by leakage of a fluid system must be identified and defined.

EXTERNAL LOAD ATTACHING MEANS

§ 27.865 External load attaching means.

(a) It must be shown by analysis or test, or both, that the rotorcraft external-load attaching means can withstand a limit static load equal to 2.5 times the maximum external load for which authorization is requested, applied in the vertical direction and in any direction making an angle of 30 degrees with the vertical, except for those directions having a forward component. However, the 30-degree angle may be reduced to a lesser angle if—

(1) An operating limitation is established limiting external load operations to such angles for which compliance with this paragraph has been shown; or

(2) It is shown that the lesser angle can not be exceeded in service.

(b) The external load attaching means for Class B and Class C rotorcraft-load combinations must include a device to enable the pilot to release the external load quickly during flight. This quick-release device, and the means by which it is controlled, must comply with the following:

(1) A control for the quick-release device must be installed on one of the pilot's primary controls and must be designed and located so that it may be operated by the pilot without hazardously limiting his ability to control the rotorcraft during an emergency situation.

(2) In addition a manual mechanical control for the quick-release device, readily accessible either to the pilot or to another crewmember, must be provided.

(3) The quick-release device must function properly with all external loads up to and including the maximum external load for which authorization is requested.

(c) A placard or marking must be installed next to the external-load attaching means stating the maximum authorized external load as demonstrated under § 27.25 and this section.

MISCELLANEOUS

§ 27.871 Leveling marks.

There must be reference marks for leveling the rotorcraft on the ground.

§ 27.873 Ballast provisions.

Ballast provisions must be designed and constructed to prevent inadvertent shifting of ballast in flight.

Subpart E—Powerplant

GENERAL

§ 27.901 Installation.

(a) For the purpose of this Part, the powerplant installation includes each part of the rotorcraft (other than the main and auxiliary rotor structures) that—

(1) Is necessary for propulsion;

(2) Affects the control of the major propulsive units; or

(3) Affects the safety of the major propulsive units between normal inspections or overhauls.

(b) For each powerplant installation—

(1) Each component of the installation must be constructed, arranged, and installed to ensure its continued safe operation between normal inspections or overhauls;

(2) Accessibility must be provided to allow any inspection and maintenance necessary for continued airworthiness; and

(3) Electrical interconnections must be provided to prevent differences of potential between major components of the installation and the rest of the rotorcraft.

(4) Axial and radial expansion of turbine engines may not affect the safety of the installation.

(c) The installation must comply with—

(1) The installation instructions provided under § 33.5 of this chapter; and

(2) The applicable provisions of this subpart.

§ 27.903 Engines.

(a) *Engine type certification.* **[**Each engine must have a type certificate.**]**

(b) *Engine cooling fan blade protection.* If an engine cooling fan is installed, there must be means to protect the rotorcraft and allow a safe landing if a fan blade fails. This must be shown by showing that--

(1) The fan blades are contained in case of failure;

(2) Each fan is located so that a failure will not jeopardize safety; or

(3) Each fan blade can withstand an ultimate load of 1.5 times the centrifugal force resulting from engine r.p.m. limited by either—

(i) The terminal engine r.p.m. under uncontrolled conditions; or

(ii) An overspeed limiting device.

(c) *Turbine engine installation.* For turbine engine installations, the powerplant systems associated with engine control devices, systems, and instrumentation must be designed to give reasonable assurance that those engine operating limitations that adversely affect turbine rotor structural integrity will not be exceeded in service.

§ 27.907 Engine vibration.

(a) Each engine must be installed to prevent the harmful vibration of any part of the engine or rotorcraft.

(b) The addition of the rotor and the rotor drive system to the engine may not subject the principal rotating part of the engine to excessive vibration stresses. This must be shown by a vibration investigation.

(c) No part of the rotor drive system may be subjected to excessive vibration stresses.

ROTOR DRIVE SYSTEM

§ 27.917 Design.

(a) Each rotor drive system must incorporate a unit for each engine to automatically disengage that engine from the main and auxiliary rotors if that engine fails.

(b) Each rotor drive system must be arranged so that each rotor necessary for control in autorotation will continue to be driven by the main rotors after disengagement of the engine from the main and auxiliary rotors.

(c) If a torque limiting device is used in the rotor drive system, it must be located so as to allow continued control of the rotorcraft when the device is operating.

(d) The rotor drive system includes any part necessary to transmit power from the engines to the rotor hubs. This includes gear boxes, shafting, universal joints, couplings, rotor brake assemblies, clutches, supporting bearings for shafting, any attendant accessory pads or drives, and any cooling fans that are a part of, attached to, or mounted on the rotor drive system.

§ 27.921 Rotor brake.

If there is a means to control the rotation of the rotor drive system independently of the engine, any limitations on the use of that means must be specified, and the control for that means must be guarded to prevent inadvertent operation.

§ 27.923 Rotor drive system and control mechanism tests.

(a) Each part tested as prescribed in this section must be in a serviceable condition at the end of the tests. No intervening disassembly which might affect test results may be conducted.

(b) Each rotor drive system and control mechanism must be tested for not less than 100 hours. The test must be conducted on the rotorcraft, and the torque must be absorbed by the rotors to be installed, except that other ground or flight test facilities with other appropriate methods of torque absorptions may be used if the conditions of support and vibration closely simulate the conditions that would exist during a test on the rotorcraft.

(c) A 60-hour part of the test prescribed in paragraph (b) of this section must be run at not less than the torque corresponding to maximum continuous engine power and r.p.m. In this test, the main rotor must be set in the position that will give maximum longitudinal cyclic pitch change to simulate forward flight. The auxiliary rotor controls must be in the position for normal operation under the conditions of the test.

(d) A 30-hour part of the test prescribed in paragraph (b) of this section must be run at not less than the torque corresponding to 75 percent of maximum continuous engine power and the minimum engine speed intended for this power. The main and auxiliary rotor controls must be in the position for normal operation under the conditions of the test.

(e) A 10-hour part of the test prescribed in paragraph (b) of this section must be run at not less than the torque corresponding to takeoff engine power and r.p.m. The main and auxiliary rotor controls must be in the normal position for vertical ascent. For multi-engine helicopters for which the use of 2½ minute power is requested, three runs during the 10-hour test must be conducted as follows:

(1) Each run must consist of at least one period of 2½ minutes at the torque corresponding to takeoff power and speed on all engines.

(2) Each run must consist of at least one period for each engine in sequence, during which that engine simulates a power failure and the remaining engines are run

at the torque corresponding to 2½ minute power and speed for 2½ minutes.

(f) The parts of the test prescribed in paragraphs (c) and (d) of this section must be conducted in intervals of not less than 30 minutes and may be accomplished either on the ground or in flight. The part of the test prescribed in paragraph (e) of this section must be conducted in intervals of not less than 5 minutes.

(g) At intervals of not more than 5 hours during the tests prescribed in paragraphs (c), (d), and (e) of this section, the engine must be stopped rapidly enough to allow the engine and rotor drive to be automatically disengaged from the rotors.

(h) Under the operating conditions specified in paragraph (c) of this section, 500 complete cycles of lateral control, 500 complete cycles of longitudinal control of the main rotors, and 500 complete cycles of control of each auxiliary rotor must be accomplished. A "complete cycle" involves movement of the controls from the neutral position, through both extreme positions, and back to the neutral position, except that control movements need not produce loads or flapping motions exceeding the maximum loads or motions encountered in flight. The cycling may be accomplished during the testing prescribed in paragraph (c) of this section.

(i) At least 200 start-up clutch engagements must be accomplished—

(1) So that the shaft on the driven side of the clutch is accelerated; and

(2) Using a speed and method selected by the applicant.

(j) For multiengine helicopters for which the use of 30-minute power is requested, a run must be made at the torque corresponding to 30-minute power and minimum speed intended for this power, in which each engine, in sequence, is shut down and the remaining engines are run for a 30-minute period.

§ 27.927 Additional tests.

(a) Any additional dynamic, endurance, and operational tests, and vibratory investigations necessary to determine that the rotor drive mechanism is safe, must be performed.

(b) If turbine engine torque output to the transition can exceed the highest engine or transmission torque rating limit, and that output is not directly controlled by the pilot under normal operating conditions (such as where the primary engine power control is accomplished through the flight control), the following test must be made:

(1) Under conditions associated with all engines operating, make 200 applications, for 10 seconds each, of torque that is at least equal to the lesser of—

(i) The maximum torque used in meeting § 27.923 plus 10 percent; or

(ii) The maximum attainable torque output of the engines, assuming that torque limiting devices, if any, function properly.

(2) For multiengine rotorcraft under conditions associated with each engine, in turn, becoming inoperative, apply to the remaining transmission torque inputs the maximum torque attainable under probable operating conditions, assuming that torque limiting devices, if any, function properly. Each transmission input must be tested at this maximum torque for at least 15 minutes.

(3) The tests prescribed in this paragraph must be conducted on the rotorcraft and the torque must be absorbed by the rotors to be installed, except that other ground or flight test facilities with other appropriate methods of torque absorption may be used if the conditions of support and vibration closely simulate the conditions that would exist during a test on the rotorcraft.

(c) It must be shown by tests that the rotor drive system is capable of operating under autorotative conditions for 15 minutes after the loss of pressure in the rotor drive primary oil system.

§ 27.931 Shafting critical speed.

(a) The critical speeds of any shafting must be determined by demonstration, except that analytical methods may be used if reliable methods of analysis are available for the particular design.

(b) If any critical speed lies within, or close to, the operating ranges for idling, power on, and autorotative conditions, the stresses occurring at that speed must be within safe limits. This must be shown by tests.

(c) If analytical methods ae used and show that no critical speed lies within the permissible operating ranges, the margins between the calculated critical speeds and the limits of the allowable operating ranges must be adequate to allow for possible variations between the computed and actual values.

§ 27.935 Shafting joints.

Each universal joint, slip joint, and other shafting joints whose lubrication is necessary for operation must have provision for lubrication.

§ 27.939 Turbine engine operating characteristics.

(a) Turbine engine operating characteristics must be investigated in flight to determine that no adverse characteristics (such as stall, surge, or flameout) are present, to a hazardous degree, during normal and emergency operation within the range of operating limitations of the rotorcraft and of the engine.

(b) The turbine engine air inlet system may not, as a result of airflow distortion during normal operation, cause vibration harmful to the engine.

(c) For governor-controlled engines, it must be shown that there exists no hazardous torsional instability of the drive system associated with critical combinations of power, rotational speed, and control displacement.

FUEL SYSTEM

§ 27.951 General.

(a) Each fuel system must be constructed and arranged to ensure a flow of fuel at a rate and pressure established for proper engine functioning under any likely operating condition, including the maneuvers for which certification is requested.

(b) Each fuel system must be arranged so that—

(1) No fuel pump can draw fuel from more than one tank at a time; or

(2) There are means to prevent introducing air into the system.

(c) Each fuel system for a turbine engine must be capable of sustained operation throughout its flow and pressure range with fuel initially saturated with water at 80°F and having 0.75cc of free water per gallon added and cooled to the most critical condition for icing likely to be encountered in operation.

§ 27.953 Fuel system independence.

(a) Each fuel system for multiengine rotorcraft must allow fuel to be supplied to each engine through a system independent of those parts of each system supplying fuel to other engines. However, separate fuel tanks need not be provided for each engine.

(b) If a single fuel tank is used on a multiengine rotorcraft, the following must be provided:

(1) Independent tank outlets for each engine, each incorporating a shutoff valve at the tank. This shutoff valve may also serve as the firewall shutoff valve required by § 27.995 if the line between the valve and the engine compratment does not contain a hazardous amount of fuel that can drain into the engine compartment.

(2) At least two vents arranged to minimize the probability of both vents becoming obstructed simultaneously.

(3) Filler caps designed to minimize the probability of incorrect installation or inflight loss.

(4) A fuel system in which those parts of the system from each tank outlet to any engine are independent of each part of each system supplying fuel to other engines.

§ 27.955 Fuel flow.

(a) Each fuel system must provide at least 100 percent of the fuel flow required under the intended operating conditions and maneuvers. This must be shown as follows:

(1) Fuel must be delivered to each engine at a pressure within the limits specified in the engine type certificate.

(2) The quantity of fuel in the tank may not exceed that established as the unusable fuel supply for that tank under § 27.959 plus that necessary to show compliance with this section.

(3) Each main pump must be used that is necessary for each operating condition and attitude for which compliance with this section is shown, and the appropriate emergency pump must be substituted for each main pump so used.

(b) If an engine can be supplied with fuel from more than one tank, the fuel system must feed promptly when fuel becomes low in one tank and another tank is selected.

§ 27.959 Unusable fuel supply.

The unusable fuel supply for each tank must be established as not less than the quantity at which the first evidence of malfunction occurs under the most adverse fuel feed condition occurring under any intended operations and flight maneuvers involving that tank.

§ 27.961 Fuel system hot weather operation.

Each suction lift fuel system and other fuel systems conducive to vapor formation must be free from vapor lock when using fuel at a temperature of 110° F. under critical operating conditions. This must be shown by test.

§ 27.963 Fuel tanks: general.

(a) Each fuel tank must be able to withstand, without failure, the vibration, inertia, fluid, and structural loads to which it may be subjected in operation.

(b) Each fuel tank of 10 gallons or greater capacity must have internal baffles, or must have external support to resist surging.

(c) Each fuel tank must be separated from the engine compartment by a firewall. At least one-half inch of clear airspace must be provided between the tank and the firewall.

(d) Spaces adjacent to the surfaces of fuel tanks must be ventilated so that fumes cannot accumulate in the tank compartment in case of leakage. If two or more tanks have interconnected outlets, they must be considered as one tank, and the airspaces in those tanks must be interconnected to prevent the flow of fuel from one tank to another as a result of a difference in pressure between those airspaces.

§ 27.965 Fuel tank tests.

(a) Each fuel tank must be able to withstand the applicable pressure tests in this section without failure or leakage. If practicable, test pressures may be applied in a manner simulating the pressure distribution in service.

(b) Each conventional metal tank, nonmetallic tank with walls that are not supported by the rotorcraft structure, and integral tank must be subjected to a pressure of 3.5 p.s.i. unless the pressure developed during maximum limit acceleration or emergency deceleration with a full tank exceeds this value, in which case a hydrostatic head, or equivalent test, must be applied to duplicate the acceleration loads as far as possible. However, the pressure need not exceed 3.5 p.s.i. on surfaces not exposed to the acceleration loading.

(c) Each nonmetallic tank with walls supported by the rotorcraft structure must be subjected to the following tests:

(1) A pressure test of at least 2.0 p.s.i. This test may be conducted on the tank alone in conjunction with the test specified in paragraph (c)(2) of this section.

(2) A pressure test, with the tank mounted in the rotorcraft structure, equal to the load developed by the reaction of the contents, with the tank full, during maximum limit acceleration or emergency deceleration. However, the pressure need not exceed 2.0 p.s.i. on surfaces not exposed to the acceleration loading.

(d) Each tank with large unsupported or unstiffened flat areas, or with other features whose failure or deformation could cause leakage, must be subjected to the following test or its equivalent:

(1) Each complete tank assembly and its support must be vibration tested while mounted to simulate the actual installation.

(2) The tank assembly must be vibrated for 25 hours while two-thirds full of any suitable fluid. The amplitude of vibration may not be less than one thirty-second of an inch, unless otherwise substantiated.

(3) The test frequency of vibration must be as follows:

(i) If no frequency of vibration resulting from any r.p.m. within the normal operating range of engine or rotor system speeds is critical, the test frequency of vibration, in number of cycles per minute must, unless a frequency based on a more rational calculation is used, be the number obtained by averaging the maximum and minimum power-on engine speeds (r.p.m.) for reciprocating engine powered rotorcraft or 2,000 c.p.m. for turbine engine powered rotorcraft.

(ii) If only one frequency of vibration resulting from any r.p.m. within the normal operating range of engine or rotor system speeds is critical, that frequency of vibration must be the test frequency.

(iii) If more than one frequency of vibration resulting from any r.p.m. within the normal operating range of engine or rotor system speeds is critical, the most critical of these frequencies must be the test frequency.

(4) Under paragraphs (d)(3)(ii) and (iii) of this section, the time of test must be adjusted to accomplish the same number of vibration cycles as would be accomplished in 25 hours at the frequency specified in paragraph (d)(3)(i) of this section.

(5) During the test, the tank assembly must be rocked at the rate of 16 to 20 complete cycles per minute through an angle of 15 degrees on both sides of the horizontal (30 degrees total), about the most critical axis, for 25 hours. If motion about more than one axis is likely to be critical, the tank must be rocked about each critical axis for 12½ hours.

§ 27.969 Fuel tank expansion space.

Each fuel tank must have an expansion space of not less than two percent of the tank capacity. It must be impossible to fill the fuel tank expansion space inadvertently with the rotorcraft in the normal ground attitude.

§ 27.971 Fuel tank sump.

Each fuel tank must have a sump and drain at the point in the tank that is lowest with the rotorcraft in the normal ground attitude. The main fuel supply may not be drawn from the bottom of the sump.

§ 27.973 Fuel tank filler connection.

Each fuel tank filler connection must prevent the entrance of fuel into any part of the rotorcraft other than the tank.

§ 27.975 Fuel tank vents.

Each fuel tank must be vented from the top part of the expansion space so that venting is effective under all normal flight conditions. Each vent must minimize the probability of stoppage by dirt or ice.

[§ 27.977 Fuel tank outlet.

[(a) There must be a fuel strainer for the fuel tank outlet or for the booster pump. This strainer must—

[(1) For reciprocating engine powered rotorcraft, have 8 to 16 meshes per inch; and

[(2) For turbine engine powered rotorcraft, prevent the passage of any object that could restrict fuel flow or damage any fuel system component.

[(b) The clear area of each fuel tank outlet strainer must be at least five times the area of the outlet line.

[(c) The diameter of each strainer must be at least that of the fuel tank outlet.

[(d) Each finger strainer must be accessible for inspection and cleaning.]

FUEL SYSTEM COMPONENTS

§ 27.991 Fuel pumps.

(a) *Main pumps.* Each fuel pump required for proper engine operation, or required to meet the fuel system requirements of this subpart (other than those in paragraph (b) of this section), is a main pump. For each main pump, there must be means to allow the bypass of each positive displacement fuel pump other than a fuel injection pump (a pump that supplies the proper flow and pressure for fuel injection when the injection is not accomplished in a carburetor) approved as part of an engine.

(b) *Emergency pumps.* There must be emergency pumps, or another main pump, to feed the engines immediately after the failure of any main pump (other than fuel injection pump approved as part of the engine). Each pump used for this purpose must be activated automatically or operated continuously so that enough fuel pressure will be maintained to prevent engine stoppage.

§ 27.993 Fuel system lines and fittings.

(a) Each fuel line must be installed and supported to prevent excessive vibration and to withstand loads due to fuel pressure and accelerated flight conditions.

(b) Each fuel line connected to components of the rotorcraft between which relative motion could exist must have provisions for flexibility.

(c) Flexible hose must be approved.

(d) Each flexible connection in fuel lines that may be under pressure or subjected to axial loading must use flexible hose assemblies.

(e) No flexible hose that might be adversely affected by high temperatures may be used where excessive temperatures will exist during operation or after engine shutdown.

§ 27.995 Fuel valves.

(a) There must be a positive, quick-acting valve to shut off fuel to each engine individually.

(b) The control for this valve must be within easy reach of appropriate crewmembers.

(c) Where there is more than one source of fuel supply there must be means for independent feeding from each source.

(d) No shutoff valve may be on the engine side of any firewall.

§ 27.997 Fuel strainer or filter.

There must be a fuel strainer or filter between the fuel tank outlet and the inlet of either the fuel metering device or an engine driven positive displacement pump, whichever is nearer the fuel tank outlet. This fuel strainer or filter must—

(a) Be accessible for draining and cleaning and must incorporate a screen or element which is easily removable;

(b) Have a sediment trap and drain except that it need not have a drain if the strainer or filter is easily removable for drain purposes;

[(c) Be mounted so that its weight is not supported by the connecting lines or by the inlet or outlet connections of the strainer or filter itself, unless adequate strength margins under all loading conditions are provided in the lines and connections; and]

[(d) Have the capacity (with respect to operating limitations established for the engine) to ensure that engine fuel system functioning is not impaired, with the fuel contaminated to a degree (with respect to particle size and density) that is greater than that established for the engine in Part 33 of this Chapter.]

§ 27.999 Fuel system drains.

(a) There must be at least one accessible drain at the lowest point in each fuel system to completely drain the system with the rotorcraft in its normal attitude on level ground.

(b) Each drain required by paragraph (a) of this section must—

(1) Discharge clear of all parts of the rotorcraft;

(2) Have manual or automatic means for positive locking in the closed position; and

(3) Have a drain valve—

(i) That is readily accessible and which can be easily opened and closed; and

(ii) That is either located or protected to prevent fuel spillage in the event of a landing with landing gear retracted.

OIL SYSTEM

§ 27.1011 General.

(a) Each engine must have an independent oil system that can supply it with an appropriate quantity of oil at a temperature not above that safe for continuous operation.

(b) The usable oil capacity of each system may not be less than the product of the endurance of the rotorcraft under critical operating conditions and the maximum oil consumption of the engine under the same conditions, plus a suitable margin to ensure adequate circulation and cooling. Instead of a rational analysis of endurance and consumption, a usable oil capacity of 1 gallon for each 40 gallons of usable fuel may be used.

(c) The oil cooling provisions for each engine must be able to maintain the oil inlet temperature to that engine at or below the maximum established value. This must be shown by flight tests.

§ 27.1013 Oil tanks.

Each oil tank must be designed and installed so that—

(a) It can withstand, without failure, each vibration, inertia, fluid, and structural load expected in operation;

(b) [Reserved]

(c) Where used with a reciprocating engine, it has an expansion space of not less than the greater of 10 percent of the tank capacity or 0.5 gallon, and where used with a turbine engine, it has an expansion space of not less than 10 percent of the tank capacity.

(d) It is impossible to fill the tank expansion space inadvertently with the rotorcraft in the normal ground attitude;

(e) Adequate venting is provided; and

(f) There are means in the filler opening to prevent oil overflow from entering the oil tank compartment.

§ 27.1015 Oil tank tests.

Each oil tank must be designed and installed so that it can withstand, without leakage, an internal pressure of 5 p.s.i., except that each pressurized oil tank used with a turbine engine must be designed and installed so that it can withstand, without leakage, an internal pressure of 5 p.s.i., plus the maximum operating pressure of the tank.

§ 27.1017 Oil lines and fittings.

(a) Each oil line must be supported to prevent excessive vibration.

(b) Each oil line connected to components of the rotorcraft between which relative motion could exist must have provisions for flexibility.

(c) Flexible hose must be approved.

(d) Each oil line must have an inside diameter of not less than the inside diameter of the engine inlet or outlet. No line may have splices between connections.

§ 27.1019 Oil strainer or filter.

(a) Each turbine engine installation must incorporate an oil strainer or filter through which all of the engine oil flows and which meets the following requirements:

(1) Each oil strainer or filter that has a bypass must be constructed and installed so that oil will flow at the normal rate through the rest of the system with the strainer or filter completely blocked.

[(2) The oil strainer or filter must have the capacity (with respect to operating limitations established for the engine) to ensure that engine oil system functioning is not impaired when the oil is contaminated to a degree (with respect to particle size and density) that is greater than that established for the engine under Part 33 of this Chapter.

[(3) The oil strainer or filter, unless it is installed on an oil tank outlet, must incorporate an indicator that will indicate contamination before it reaches the capacity established in accordance with subparagraph (2) of this paragraph.]

(4) The bypass of a strainer or filter must be constructed and installed so that the release of collected contaminants is minimized by appropriate location of the bypass to ensure that collected contaminants are not in the bypass flow path.

(5) An oil strainer or filter that has no bypass, except one that is installed at an oil tank outlet, must have a means to connect it to the warning system required in § 27.1305(r).

(b) Each oil strainer or filter in a powerplant installation using reciprocating engines must be constructed and installed so that oil will flow at the normal rate through the rest of the system with the strainer or filter element completely blocked.

[§ 27.1021 Oil system drains.

[A drain (or drains) must be provided to allow safe drainage of the oil system. Each drain must—

[(a) Be accessible; and

[(b) Have manual or automatic means for positive locking in the closed position.]

COOLING

§ 27.1041 General.

(a) Each powerplant cooling system must be able to maintain the temperatures of powerplant components and engine fluids within the limits established for those components and fluids under any critical surface (ground or water) and flight operating conditions, and after normal engine shutdown.

(b) Compliance with paragraph (a) of this section must be shown in tests conducted under the conditions prescribed in that paragraph.

§ 27.1043 Cooling tests.

(a) *General.* For the tests prescribed in § 27.1041(b), the following apply:

(1) If the tests are conducted under conditions deviating from the maximum ambient atmospheric temperature specified in paragraph (b) of this section, the recorded powerplant temperatures must be corrected under paragraphs (c) and (d) of this section unless a more rational correction method is applicable.

(2) No corrected temperature determined under subparagraph (1) of this paragraph may exceed established limits.

(3) For reciprocating engines, the fuel used during the cooling tests must be of the minimum grade approved for the engines, and the mixture settings must be those normally used in the flight stages for which the cooling tests are conducted.

(4) The test procedures must be as prescribed in § 27.1045.

[(b) *Maximum ambient atmospheric temperature.* A maximum ambient atmospheric temperature corresponding to sea level conditions of at least 100 degrees F must be established. The assumed temperature lapse rate is 3.6 degrees F per thousand feet of altitude above sea level until a temperature of −69.7 degrees F is reached, above which altitude the temperature is considered constant at −69.7 degrees F. However, for winterization installations, the applicant may select a maximum ambient atmospheric temperature corresponding to sea level conditions of less than 100 degrees F.]

(c) *Correction factor (except cylinder barrels).* Unless a more rational correction applies, temperatures of engine fluids and power-plant components (except cylinder barrels) for which temperature limits are established, must be corrected by adding to them the difference between the maximum ambient atmospheric temperature and the temperature of the ambient air at the time of the first occurrence of the maximum component or fluid temperature recorded during the cooling test.

(d) *Correction factor for cylinder barrel temperatures.* Cylinder barrel temperatures must be corrected by adding to them 0.7 times the difference between the [maximum ambient atmospheric temperature] and the temperature of the ambient air at the time of the first occurrence of the maximum cylinder barrel temperature recorded during the cooling test.

§ 27.1045 Cooling test procedures.

(a) *General.* For each stage of flight, the cooling tests must be conducted with the rotorcraft—

(1) In the configuration most critical for cooling; and

(2) Under the conditions most critical for cooling.

(b) *Temperature stabilization.* For the purpose of the cooling tests, a temperature is "stabilized" when its rate of change is less than 2° F. per minute. The following component and engine fluid temperature stabilization rules apply:

(1) For each rotorcraft, and for each stage of flight—

(i) The temperatures must be stabilized under the conditions from which entry is made into the stage of flight being investigated; or

(ii) If the entry condition normally does not allow temperatures to stabilize, operation through the fuel entry condition must be conducted before entry into the stage of flight being investigated in order to allow the temperatures to attain their natural levels at the time of entry.

(2) For each helicopter during the takeoff stage of flight, the climb at takeoff power must be preceded by a period of hover during which the temperatures are stabilized.

(c) *Duration of test.* For each stage of flight the tests must be continued until—

(1) The temperatures stabilize;

(2) That stage of flight is completed; or

(3) An operating limitation is reached.

INDUCTION SYSTEM

§ 27.1091 Air induction.

(a) The air induction system for each engine must supply the air required by that engine under the operating conditions and maneuvers for which certification is requested.

(b) Each cold air induction system opening must be outside the cowling if backfire flames can emerge.

(c) If fuel can accumulate in any air induction system, that system must have drains that discharge fuel—

(1) Clear of the rotorcraft; and

(2) Out of the path of exhaust flames.

(d) Operation of turbine engines from idle power and r.p.m. to the power and r.p.m. necessary for lift-off may not result in pebble ingestion into the induction air inlet with the rotorcraft on a pebble bed at least 1½ inches deep, consisting of pebbles that—

(1) Can pass through one-half inch mesh screening but not through one-eighth inch mesh screening; and

(2) Are spread over an area that extends horizontally 5 feet beyond the tips of the main rotors.

(e) For turbine engine powered rotorcraft—

(1) There must be means to prevent hazardous quantities of fuel leakage or overflow from drain, vents, or other components of flammable fluid systems from entering the engine intake system; and

(2) The air inlet ducts must be located or protected so as to minimize the ingestion of foreign matter during takeoff, landing, and taxiing.

§ 27.1093 Induction system icing protection.

(a) *Reciprocating engines.* Each reciprocating engine air induction system must have means to prevent and eliminate icing. Unless this is done by other means, it must be shown that, in air free of visible moisture at a temperature of 30° F., and with the engines at 75 percent of maximum continuous power—

(1) Each rotorcraft with sea level engines using conventional venturi carburetors has a preheater that can provide a heat rise of 90° F.;

(2) Each rotorcraft with sea level engines using carburetors tending to prevent icing has a sheltered alternate source of air, and that the preheat supplied to the alternate air intake is not less than that provided by the engine cooling air downstream of the cylinders;

(3) Each rotorcraft with altitude engines using conventional venturi carburetors has a preheater capable of providing a heat rise of 120° F.; and

(4) Each rotorcraft with altitude engines using carburetors tending to prevent icing has a preheater that can provide a heat rise of—

(i) 100° F.; or

(ii) If a fluid deicing system is used, at least 40°F.

(b) *Turbine engines.*

(1) Each turbine engine and its air inlet system must operate throughout the flight power range of the engine (including idling), within the limitations established for the rotorcraft without the accumulation of ice on engine or inlet system components that would adversely affect engine operation or cause a serious loss of power or thrust—

(i) Under the icing conditions specified in Appendix C of Part 25 of this Chapter; and

(ii) In snow, both falling and blowing.

[(2) Each turbine engine must idle for 30 minutes on the ground, with the air bleed available for engine icing protection at its critical condition, without adverse effect, in an atmosphere that is at a temperature between 15° and 30°F (between −9° and −1°C) and has a liquid water content not less than 0.3 grams per cubic meter in the form of drops having a mean effective diameter of not less than 20 microns, followed by momentary operation at takeoff power or thrust. During the 30 minutes of idle operation, the engine may be run up periodically to a moderate power or thrust setting in a manner acceptable to the Administrator.]

(c) *Supercharged reciprocating engines.* For each engine having superchargers to pressurize the air before it enters the carburetor, the heat rise in the air caused by that supercharging at any altitude may be utilized in determining compliance with paragraph (a) of this section if the heat rise utilized is that which will be available, automatically, for the applicable altitude and operating condition because of supercharging.

EXHAUST SYSTEM

§ 27.1121 General.

For each exhaust system—

(a) There must be means for thermal expansion of manifolds and pipes;

(b) There must be means to prevent local hot spots;

(c) Exhaust gases must discharge clear of the engine air intake, fuel system components, and drains;

[(d) Each exhaust system part with a surface hot enough to ignite flammable fluids or vapors must be located or shielded so that leakage from any system carrying flammable fluids or vapors will not result in a fire caused by impingement of the fluids or vapors on any part of the exhaust system including shields for the exhaust system.]

(e) Exhaust gases may not impair pilot vision at night due to glare; and

(f) If significant traps exist, each turbine engine exhaust system must have drains discharging clear of the rotorcraft, in any normal ground and flight attitudes, to prevent fuel accumulation after the failure of an attempted engine start.

[(g) Each exhaust heat exchanger must incorporate means to prevent blockage of the exhaust port after any internal heat exchanger failure.]

§ 27.1123 Exhaust piping.

(a) Exhaust piping must be heat and corrosion resistant, and must have provisions to prevent failure due to expansion by operating temperatures.

(b) Exhaust piping must be supported to withstand any vibration and inertia loads to which it would be subjected in operations.

(c) Exhaust piping connected to components between which relative motion could exist must have provisions for flexibility.

POWERPLANT CONTROLS AND ACCESSORIES

§ 27.1141 Powerplant controls: general.

(a) Powerplant controls must be located and arranged under § 27.777 and marked under § 27.1555.

(b) Each flexible powerplant control must be approved.

[(c) Powerplant valve controls located in the cockpit must have—

[(1) For manual valves, positive stops or in the case of fuel valves suitable index provisions, in the open and closed position; and

[(2) For power-assisted valves, a means to indicate to the flight crew when the valve—

[(i) Is in the fully open or fully closed position; or

[(ii) Is moving between the fully open and fully closed position.

[(d) For turbine engine powered rotorcraft, no single failure or malfunction, or probable combination thereof, in any powerplant control system may cause the failure of any powerplant function necessary for safety.]

§ 27.1143 Engine controls.

(a) There must be a separate throttle control for each engine.

(b) Throttle controls must be grouped and arranged to allow—

(1) Separate control of each engine; and

(2) Simultaneous control of all engines.

(c) Each throttle control must provide a positive and immediately responsive means of controlling its engine.

[(d) If a power or thrust control incorporates a fuel shutoff feature, the control must have a means to prevent the inadvertent movement of the control into the shutoff position. The means must—

(1) Have a positive lock or stop at the idle position; and

(2) Require a separate and distinct operation to place the control in the shutoff position.

§ 27.1145 Ignition switches.

(a) There must be means to quickly shut off all ignition by the grouping of switches or by a master ignition control.

[(b) Each group of ignition switches, except ignition switches for turbine engines for which continuous ignition is not required, and each master ignition control must have a means to prevent its inadvertent operation.]

§ 27.1147 Mixture controls.

If there are mixture controls, each engine must have a separate control and the controls must be arranged to allow—

(a) Separate control of each engine; and

(b) Simultaneous control of all engines.

§ 27.1163 Powerplant accessories.

[(a) Each engine-mounted accessory must—

[(1) Be approved for mounting on the engine involved;

[(2) Use the provisions on the engine for mounting; and

[(3) Be sealed in such a way as to prevent contamination of the engine oil system and the accessory system.]

(b) Torque limiting means must be provided on all accessory drives that are located on the transmission, including drives on gearboxes that are part of the transmission, in order to prevent the torque limits established for those drives from being exceeded.

POWERPLANT FIRE PROTECTION

§ 27.1183 [Lines, fittings, and components.]

(a) Except as provided in paragraph (b) of this section, each line, fitting, and other component carrying flammable fluid in any area subject to engine fire conditions must be fire resistant, except that flammable fluid tanks and supports which are part of and attached to the engine must be fireproof or be enclosed by a fireproof shield unless damage by fire to any non-fireproof part will not cause leakage or spillage of flammable fluid. Components must be shielded or located so as to safeguard against the ignition of leaking flammable fluid. An integral oil sump of less than [25-quart] capacity on a reciprocating engine need not be fireproof nor be enclosed by a fireproof shield.

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(b) Paragraph (a) does not apply to—

[(1) Lines, fittings, and components which and are already approved as part of a type certificated engine; and]

(2) Vent and drain lines, and their fittings, whose failure will not result in, or add to, a fire hazard.

(c) Each flammable fluid drain and vent must discharge clear of the induction system air inlet.

§ 27.1185 Flammable fluids.

(a) Each fuel tank must be isolated from the engines by a firewall or shroud.

(b) Each tank or reservoir, other than a fuel tank, that is part of a system containing flammable fluids or gases must be isolated from the engine by a firewall or shroud, unless the design of the system, the materials used in the tank and its supports, the shutoff means, and the connections, lines and controls provide a degree of safety equal to that which would exist if the tank or reservoir were isolated from the engines.

(c) There must be at least one-half inch of clear airspace between each tank and each firewall or shroud isolating that tank, unless equivalent means are used to prevent heat transfer from each engine compartment to the flammable fluid.

§ 27.1187 Ventilation.

Each compartment containing any part of the powerplant installation must have provision for ventilation.

§ 27.1189 Shutoff means.

(a) There must be means to shut off each line carrying flammable fluids into the engine compartment, except—

[(1) Lines, fittings, and components forming an integral part of an engine;

[(2) For oil systems for which all components of the system, including oil tanks, are fireproof or located in areas not subject to engine fire conditions; and]

[(3)] For reciprocating engine installations only, engine oil system lines in installations using engines of less than 500 cu. in. displacement.

(b) There must be means to guard against inadvertent operation of each shutoff, and to make it possible for the crew to reopen it in flight after it has been closed.

(c) Each shutoff valve and its controls must be on the remote side of the firewall from the engine if they cannot function under any fire condition likely to result from an engine fire.

§ 27.1191 Firewalls.

(a) Each engine, including the combustor, turbine, and tailpipe sections of turbine engines must be isolated by a firewall, shroud, or equivalent means, from personnel compartments, structures, controls, rotor mechanisms, and other parts that are—

(1) Essential to a controlled landing; and

(2) Not protected under § 27.861.

(b) Each auxiliary power unit and combustion heater, and any other combustion equipment to be used in flight, must be isolated from the rest of the rotorcraft by firewalls, shrouds, or equivalent means.

(c) In meeting paragraphs (a) and (b) of this section, account must be taken of the probable path of a fire as affected by the airflow in normal flight and in autorotation.

(d) Each firewall and shroud must be constructed so that no hazardous quantity of air, fluids, or flame can pass from any engine compartment to other parts of the rotorcraft.

(e) Each opening in the firewall or shroud must be sealed with close-fitting, fireproof grommets, bushings, or firewall fittings.

(f) Each firewall and shroud must be fireproof and protected against corrosion.

§ 27.1193 Cowling and engine compartment covering.

(a) Each cowling and engine compartment covering must be constructed and supported so that it can resist the vibration, inertia, and air loads to which it may be subjected in operation.

(b) There must be means for rapid and complete drainage of each part of the cowling or engine compartment in the normal ground and flight attitudes.

(c) No drain may discharge where it might cause a fire hazard.

(d) Each cowling and engine compartment covering must be at least fire resistant.

(e) Each part of the cowling or engine compartment covering subject to high temperatures due to its nearness to exhaust system parts or exhaust gas impingement must be fireproof.

§ 27.1194 Other surfaces.

All surfaces aft of, and near, powerplant compartments, other than tail surfaces not subject to heat, flames, or sparks emanating from a powerplant compartment, must be at least fire resistant.

§ 27.1195 Fire detector systems.

Each turbine engine powered rotorcraft must have approved quick-acting fire detectors in numbers and locations ensuring prompt detection of fire in the engine compartment which cannot be readily observed in flight by the pilot in the cockpit.

Subpart F—Equipment

GENERAL

§ 27.1301 Function and installation.

Each item of installed equipment must—

(a) Be of a kind and design appropriate to its intended function;

(b) Be labeled as to its identification, function, or operating limitations, or any applicable combination of these factors;

(c) Be installed according to limitations specified for that equipment; and

(d) Function properly when installed.

§ 27.1303 Flight and navigation instruments.

The following are the required flight and navigation instruments:

(a) An airspeed indicator.

(b) An altimeter.

(c) A magnetic direction indicator.

§ 27.1305 Powerplant instruments.

The following are the required powerplant instruments:

(a) A carburetor air temperature indicator, for each engine having a preheater that can provide a heat rise in excess of 60° F.

(b) A cylinder head temperature indicator, for each—

(1) Air cooled engine;

(2) Rotorcraft with cooling shutters; and

(3) Rotorcraft for which compliance with § 27.1043 is shown in any condition other than the most critical flight condition with respect to cooling.

(c) A fuel pressure indicator, for each pump-fed engine.

(d) A fuel quantity indicator, for each fuel tank.

(e) A manifold pressure indicator, for each altitude engine.

(f) An oil temperature warning device to indicate when the temperature exceeds a safe value in each main rotor drive gearbox (including any gearboxes essential to rotor phasing) having an oil system independent of the engine oil system.

(g) An oil pressure warning device to indicate when the pressure falls below a safe value in each pressure-lubricated main rotor drive gearbox (including any gearboxes essential to rotor phasing) having an oil system independent of the engine oil system.

(h) An oil pressure indicator for each engine.

(i) An oil quantity indicator for each oil tank.

(j) An oil temperature indicator for each engine.

(k) At least one tachometer to indicate the r.p.m. of each engine and, as applicable—

(1) The r.p.m. of the single main rotor;

(2) The common r.p.m. of any main rotors whose speeds cannot vary appreciably with respect to each other; or

(3) The r.p.m. of each main rotor whose speed can vary appreciably with respect to that of another main rotor.

(l) If an engine can be supplied with fuel from more than one tank, a warning device to indicate, for each tank, when a 5-minute usable fuel supply remains when the rotorcraft is in the most adverse fuel feed condition for that tank, regardless of whether that condition can be sustained for the 5 minutes.

(m) Means to indicate to the pilot when each emergency pump is in operation.

(n) A gas temperature indicator for each turbine engine.

(o) Means to enable the pilot to determine the torque of each turboshaft engine, if a torque limitation is established for that engine under § 27.1521(e).

(p) For each turbine engine, an indicator to indicate the functioning of the powerplant ice protection system.

(q) For each turbine engine, an indicator for the fuel strainer or filter required by § 27.997 to indicate the occurance of contamination of the strainer of filter before it reaches the capacity established in accordance with § 27.997(d).

(r) For each turbine engine, a warning means for the oil strainer or filter required by § 27.1019, if it has no bypass, to warn the pilot of the occurrence of contamination of the strainer or filter before it reaches the capacity established in accordance with § 27.1019(a) (2).

(s) An indicator to indicate the proper functioning of any heater used to prevent ice clogging of fuel system components.

§ 27.1307 Miscellaneous equipment.

The following is the required miscellaneous equipment:

(a) An approved seat for each occupant.

(b) An approved safety belt for each occupant.

(c) A master switch arrangement.

(d) An adequate source of electrical energy, where electrical energy is necessary for operation of the rotorcraft.

(e) Electrical protective devices.

§ 27.1309 Equipment, systems, and installations.

[(a) The equipment, systems, and installations whose functioning is required by this subchapter must be designed and installed to ensure that they perform their intended functions under any foreseeable operating condition.

[(b) The equipment, systems, and installations of a multiengine rotorcraft must be designed to prevent hazards to the rotorcraft in the event of a probable malfunction or failure.

[(c) The equipment, systems, and installations of single-engine rotorcraft must be designed to minimize hazards to the rotorcraft in the event of a probable malfunction or failure.

[(d) In showing compliance with paragraph (a), (b), or (c) of this section, the effects of lightning strikes on the rotorcraft must be considered in accordance with § 27.610.]

INSTRUMENTS: INSTALLATION

§ 27.1321 Arrangement and visibility.

(a) Each flight, navigation, and powerplant instrument for use by any pilot must be easily visible to him.

(b) For each multiengine rotorcraft, identical powerplant instruments must be located so as to prevent confusion as to which engine each instrument relates.

(c) Instrument panel vibration may not damage, or impair the readability or accuracy of, any instrument.

(d) If a visual indicator is provided to indicate malfunction of an instrument, it must be effective under all probable cockpit lighting conditions.

§ 27.1322 Warning, caution, and advisory lights.

If warning, caution or advisory lights are installed in the cockpit, they must, unless otherwise approved by the Administrator, be—

(a) Red, for warning lights (lights indicating a hazard which may require immediate corrective action);

(b) Amber, for caution lights (lights indicating the possible need for future corrective action);

(c) Green, for safe operation lights; and

(d) Any other color, including white, for lights not described in paragraphs (a) through (c) of this section, provided the colors differs sufficiently from the colors prescribed in paragraphs (a) through (c) of this section to avoid possible confusion.

§ 27.1323 Airspeed indicating system.

(a) Each airspeed indicating instrument must be calibrated to indicate true airspeed (at sea level with a standard atmosphere) with a minimum practicable instrument calibration error when the corresponding pitot and static pressures are applied.

(b) The airspeed indicating system must be calibrated in flight at forward speeds of 20 knots and over.

(c) At each forward speed above 80 percent of the climbout speed, the airspeed indicator must indicate true airspeed, at sea level with a standard atmosphere, to within an allowable installation error of not more than the greater of—

(1) ±3 percent of the calibrated airspeed; or

(2) Five knots.

§ 27.1325 Static pressure systems.

(a) Each instrument with static air case connections must be vented so that the influence of rotorcraft speed, the opening and closing of windows, airflow variation, and moisture or other foreign matter does not seriously affect its accuracy.

(b) Each static pressure port must be designed and located in such manner that the correlation between air pressure in the static pressure system and true ambient atmospheric static pressure is not altered when the rotorcraft encounters icing conditions. An anti-icing means or an alternate source of static pressure may be used in showing compliance with this requirement. If the reading of the altimeter, when on the alternate static pressure system, differs from the reading of the altimeter when on the primary static system by more than 50 feet, a correction card must be provided for the alternate static system.

(c) Except as provided in paragraph (d) of this section, if the static pressure system incorporates both a primary and an alternate static pressure source, the means for selecting one or the other source must be designed so that—

(1) When either source is selected, the other is blocked off; and

(2) Both sources cannot be blocked off simultaneously.

(d) For unpressurized rotorcraft, paragraph (c) (1) of this section does not apply if it can be demonstrated that the static pressure system calibration, when either static pressure source is selected, is not changed by the other static pressure source being open or blocked.

§ 27.1327 Magnetic direction indicator.

(a) Except as provided in paragraph (b) of this section—

(1) Each magnetic direction indicator must be installed so that its accuracy is not excessively affected by the rotorcraft's vibration or magnetic fields; and

(2) The compensated installation may not have a deviation, in level flight, greater than 10 degrees on any heading.

(b) A magnetic nonstabilized direction indicator may deviate more than 10 degrees due to the operation of electrically powered systems such as electrically heated windshields if either a magnetic stabilized direction indicator, which does not have a deviation in level flight greater than 10 degrees on any heading, or a gyroscopic direction indicator, is installed. Deviations of a magnetic nonstabilized direction indicator of more than 10 degrees must be placarded in accordance with § 27.1547(e).

[§ 27.1329 Automatic pilot system.

[(a) Each automatic pilot system must be designed so that the automatic pilot can—

[(1) Be sufficiently overpowered by one pilot to allow control of the rotorcraft; and

[(2) Be readily and positively disengaged by each pilot to prevent it from interfering with control of the rotorcraft.

[(b) Unless there is automatic synchronization, each system must have a means to readily indicate to the pilot the alignment of the actuating device in relation to the control system is operates.

[(c) Each manually operated control for the system's operation must be readily accessible to the pilots.

[(d) The system must be designed and adjusted so that, within the range of adjustment available to the pilot, it cannot produce hazardous loads on the rotorcraft or create hazardous deviations in the flight path under any flight condition appropriate to its use, either during normal operation or in the event of a malfunction, assuming that corrective action begins within a reasonable period of time.

[(e) If the automatic pilot integrates signals from auxiliary controls or furnishes signals for operation of other equipment, there must be positive interlocks and sequencing of engagement to prevent improper operation.]

§ 27.1335 Flight director systems.

If a flight director system is installed, means must be provided to indicate to the flight crew its current mode of operation. Selector switch position is not acceptable as a means of indication.

§ 27.1337 Powerplant instruments.

(a) *Instruments and instrument lines.*

(1) Each powerplant instrument line must meet the requirements of §§ 27.961 and 27.993.

(2) Each line carrying flammable fluids under pressure must—

(i) Have restricting orifies or other safety devices at the source of pressure to prevent the escape of excessive fluid if the line fails; and

(ii) Be installed and located so that the escape of fluids would not create a hazard.

(3) Each powerplant instrument that utilizes flammable fluids must be installed and located so that the escape of fluid would not create a hazard.

(b) *Fuel quantity indicator.* Each fuel quantity indicator must be installed to clearly indicate to the flight crew the quantity of fuel in each tank in flight. In addition—

(1) Each fuel quantity indicator must be calibrated to read "zero" during level flight when the quantity of fuel remaining in the tank is equal to the unusable fuel supply determined under § 27.959;

(2) When two or more tanks are closely interconnected by a gravity feed system and vented, and when it is impossible to feed from each tank separately, at least one fuel quantity indicator must be installed; and

(3) Each exposed sight gauge used as a fuel quantity indicator must be protected against damage.

(c) *Fuel flowmeter system.* If a fuel flowmeter system is installed, each metering component must have a means for bypassing the fuel supply if malfunction of that component severely restricts fuel flow.

(d) *Oil quantity indicator.* There must be means to indicate the quantity of oil in each tank—

(1) On the ground (including during the filling of each tank); and

(2) In flight, if there is an oil transfer system or reserve oil supply system.

ELECTRICAL SYSTEMS AND EQUIPMENT

§ 27.1351 General.

(a) *Electrical system capacity.* Electrical equipment must be adequate for its intended use. In addition—

(1) Electric power sources, their transmission cables, and their associated control and protective devices must be able to furnish the required power at the proper voltage to each load circuit essential for safe operation; and

(2) Compliance with subparagraph (1) of this paragraph must be shown by an electrical load analysis, or by electrical measurements that take into account the electrical loads applied to the electrical system, in probable combinations and for probable durations.

(b) *Function.* For each electrical system, the following apply:

(1) Each system, when installed, must be—

(i) Free from hazards in itself, in its method of operation, and in its effects on other parts of the rotorcraft; and

(ii) Protected from fuel, oil, water, other detrimental substances, and mechanical damage.

(2) Electric power sources must function properly when connected in combination or independently.

(3) No failure or malfunction of any source may impair the ability of any remaining source to supply load circuits essential for safe operation.

(4) Each electric power source control must allow the independent operation of each source.

(c) *Generating system.* There must be at least one generator if the system supplies power to load circuits essential for safe operation. In addition—

(1) Each generator must be able to deliver its continuous rated power;

(2) Generator voltage control equipment must be able to dependably regulate each generator output within rated limits;

(3) Each generator must have a reverse current cutout designed to disconnect the generator from the battery and from the other generators when enough reverse current exists to damage that generator; and

(4) Each generator must have an overvoltage control designed and installed to prevent damage to the electrical system, or to equipment supplied by the electrical system, that could result if that generator were to develop an overvoltage condition.

(d) *Instruments.* There must be means to indicate to appropriate crewmembers the electric power system quantities essential for safe operation of the system. In addition—

(1) For direct current systems, an ammeter that can be switched into each generator feeder may be used; and

(2) If there is only one generator, the ammeter may be in the battery feeder.

(e) *External power.* If provisions are made for connecting external power to the rotorcraft, and that external power can be electrically connected to equipment other than that used for engine starting, means must be provided to ensure that no external power supply having a reverse polarity, or a reverse phase sequence, can supply power to the rotorcraft's electrical system.

§ 27.1353 Storage battery design and installation.

(a) Each storage battery must be designed and installed as prescribed in this section.

(b) Safe cell temperatures and pressures must be maintained during any probable charging and discharging condition. No uncontrolled increase in cell temperature may result when the battery is recharged (after previous complete discharge)—

(1) At maximum regulated voltage or power;

(2) During a flight of maximum duration; and

(3) Under the most adverse cooling condition likely to occur in service.

(c) Compliance with paragraph (b) of this section must be shown by test unless experience with similar batteries and installations has shown that maintaining safe cell temperatures and pressures presents no problem.

(d) No explosive or toxic gases emitted by any battery in normal operation, or as the result of any probable malfunction in the charging system or battery installation, may accumulate in hazardous quantities within the rotorcraft.

(e) No corrosive fluids or gases that may escape from the battery may damage surrounding structures or adjacent essential equipment.

(f) Each nickel cadmium battery installation capable of being used to start an engine or auxiliary power unit must have provisions to prevent any hazardous effect on structure or essential systems that may be caused by the maximum amount of heat the battery can generate during a short circuit of the battery or of its individual cells.

[(g) Nickel cadmium battery installations capable of being used to start an engine or auxiliary power unit must have—

[(1) A system to control the charging rate of the battery automatically so as to prevent battery overheating;

[(2) A battery temperature sensing and over-temperature warning system with a means for disconnecting the battery from its charging source in the event of an over-temperature condition; or

[(3) A battery failure sensing and warning system with a means for disconnecting the battery from its charging source in the event of battery failure.]

§ 27.1357 Circuit protective devices.

(a) Protective devices, such as fuses or circuit breakers, must be installed in each electrical circuit other than—

(1) The main circuits of starter motors; and

(2) Circuits in which no hazard is presented by their omission.

(b) A protective device for a circuit essential to flight safety may not be used to protect any other circuit.

(c) Each resettable circuit protective device ("trip free" device in which the tripping mechanism cannot be overridden by the operating control) must be designed so that—

(1) A manual operation is required to restore service after tripping; and

(2) If an overload or circuit fault exists, the device will open the circuit regardless of the position of the operating control.

(d) If the ability to reset a circuit breaker or replace a fuse is essential to safety in flight, that circuit breaker or fuse must be located and identified so that it can be readily reset or replaced in flight.

(e) If fuses are used, there must be one spare of each rating, or 50 percent spare fuses of each rating, whichever is greater.

§ 27.1361 Master switch.

(a) There must be a master switch arrangement to allow ready disconnection of each electric power source from the main bus. The point of disconnection must be adjacent to the sources controlled by the switch.

(b) Load circuits may be connected so that they remain energized after the switch is opened, if they are protected by circuit protective devices, rated at 5 amperes or less, adjacent to the electric power source.

(c) The master switch or its controls must be installed so that the switch is easily discernible and accessible to a crewmember in flight.

§ 27.1365 Electric cables.

(a) Each electric connecting cable must be of adequate capacity.

(b) Each cable that would overheat in the event of circuit overload or fault must be at least flame resistant and may not emit dangerous quantities of toxic fumes.

§ 27.1367 Switches.

Each switch must be—

(a) Able to carry its rated current;

(b) Accessible to the crew; and

(c) Labeled as to operation and the circuit controlled.

LIGHTS

§ 27.1381 Instrument lights.

The instrument lights must—

(a) Make each instrument, switch, and other devices for which they are provided easily readable; and

(b) Be installed so that—

(1) Their direct rays are shielded from the pilot's eyes; and

(2) No objectionable reflections are visible to the pilot.

§ 27.1383 Landing lights.

(a) Each required landing or hovering light must be approved.

(b) Each landing light must be installed so that—

(1) No objectionable glare is visible to the pilot;

(2) The pilot is not adversely affected by halation; and

(3) It provides enough light for night operation, including hovering and landing.

(c) At least one separate switch must be provided, as applicable—

(1) For each separately installed landing light; and

(2) For each group of landing lights installed at a common location.

§ 27.1385 Position light system installation.

(a) *General.* Each part of each position light system must meet the applicable requirements of this section, and each system as a whole must meet the requirements of §§ 27.1387 through 27.1397.

(b) *Forward position lights.* Forward position lights must consist of a red and a green light spaced laterally as far apart as practicable and installed forward on the rotorcraft so that, with the rotorcraft in the normal flying position, the red light is on the left side and the green light is on the right side. Each light must be approved.

(c) *Rear position light.* The rear position light must be a white light mounted as far aft as practicable, and must be approved.

(d) *Circuit.* The two forward position lights and the rear position light must make a single circuit.

(e) *Light covers and color filters.* Each light cover or color filter must be at least flame resistant and may not change color or shape or lose any appreciable light transmission during normal use.

§ 27.1387 Position light system dihedral angles.

(a) Except as provided in paragraph (e) of this section, each forward and rear position light must, as installed, show unbroken light within the dihedral angles described in this section.

(b) Dihedral angle *L* (left) is formed by two intersecting vertical planes, the first parallel to the longitudinal axis of the rotorcraft, and the other at 110° to the left of the first, as viewed when looking forward along the longitudinal axis.

(c) Dihedral angle *R* (right) is formed by two intersecting vertical planes, the first parallel to the longitudinal axis of the rotorcraft, and the other at 110° to the right of the first, as viewed when looking forward along the longitudinal axis.

(d) Dihedral angle *A* (aft) is formed by two intersecting vertical planes making angles of 70° to the right and to the left, respectively, to a vertical plane passing through the longitudinal axis, as viewed when looking aft along the longitudinal axis.

(e) If the rear position light, when mounted as far aft as practicable in accordance with § 27.1385(c), cannot show unbroken light within dihedral angle A (as defined in paragraph (d) of this section), a solid angle or angles of obstructed visibility totaling not more than 0.04 steradians is allowable within that dihedral angle, if such solid angle is within a cone whose apex is at the rear position light and whose elements make an angle of 30° with a vertical line passing through the rear position light.

§ 27.1389 Position light distribution and intensities.

(a) *General.* The intensities prescribed in this section must be provided by new equipment with light covers and color filters in place. Intensities must be determined with the light source operating at a steady value equal to the average luminous output of the source at the normal operating voltage of the rotorcraft. The light distribution and intensity of each position light must meet the requirements of paragraph (b) of this section.

(b) *Forward and rear position lights.* The light distribution and intensities of forward and rear position lights must be expressed in terms of minimum intensities in the horizontal plane, minimum intensities in any vertical plane, and maximum intensities in overlapping beams, within dihedral angles *L*, *R*, and *A*, and must meet the following requirements:

(1) *Intensities in the horizontal plane.* Each intensity in the horizontal plane (the plane containing the longitudinal axis of the rotorcraft and perpendicular to the plane of symmetry of the rotorcraft) must equal or exceed the values in § 27.1391.

(2) *Intensities in any vertical plane.* Each intensity in any vertical plane (the plane perpendicular to the horizontal plane) must equal or exceed the appropriate value in § 27.1393, where *I* is the minimum intensity prescribed in § 27.1391 for the corresponding angles in the horizontal plane.

(3) *Intensities in overlaps between adjacent signals.* No intensity in any overlap between adjacent signals may exceed the values in § 27.1395, except that higher intensities in overlaps may be used with main beam intensities substantially greater than the minima specified in §§ 27.1391 and 27.1393, if the overlap intensities in relation to the main beam intensities do not adversely affect signal clarity. When the peak intensity of the forward position lights is greater than 100 candles, the maximum overlap intensities between them may exceed the values in § 27.1395 if the overlap intensity in Area A is not more than 10 percent of peak position light intensity and the overlap intensity in Area B is not more than 2.5 percent of peak position light intensity.

§ 27.1391 Minimum intensities in the horizontal plane of forward and rear position lights.

Each position light intensity must equal or exceed the applicable values in the following table:

Dihedral angle (light included)	*Angle from right or left of longitudinal axis, measured from dead ahead*	*Intensity (candles)*
L and *R* (forward red and green).	0° to 10°	40
	10° to 20°	30
	20° to 110°	5
A (rear white)	110° to 180°	20

§ 27.1393 Minimum intensities in any vertical plane of forward and rear position lights.

Each position light intensity must equal or exceed the applicable values in the following table:

Angle above or below the horizontal plane:	*Intensity*
0°	1.00 *I.*
0° to 5°	0.90 *I.*
5° to 10°	0.80 *I.*
10° to 15°	0.70 *I.*
15° to 20°	0.50 *I.*
20° to 30°	0.30 *I.*
30° to 40°	0.10 *I.*
40° to 90°	0.05 *I.*

§ 27.1395 Maximum intensities in overlapping beams of forward and rear position lights.

No position light intensity may exceed the applicable values in the following table, except as provided in § 27.1389(b)(3).

Overlaps	*Maximum intensity*	
	Area A (candles)	*Area B (candles)*
Green in dihedral angle *L*	10	1
Red in dihedral angle *R*	10	1
Green in dihedral angle *A*	5	1
Red in dihedral angle *A*	5	1
Rear white in dihedral angle *L*	5	1
Rear white in dihedral angle *R*	5	1

Where—

(a) Area A includes all directions in the adjacent dihedral angle that pass through the light source and intersect the common boundary plane at more than 10° but less than 20°; and

(b) Area B includes all directions in the adjacent dihedral angle that pass through the light source and intersect the common boundary plane at more than 20°.

§ 27.1397 Color specifications.

Each position light color must have the applicable International Commission on Illumination chromaticity coordinates as follows:

(a) *Aviation red*—

“y” is not greater than 0.335; and

“z” is not greater than 0.002.

(b) *Aviation green*—

“x” is not greater than $0.440—0.320y$;

“x” is not greater than $y—0.170$; and

“y” is not less than $0.390—0.170x$.

(c) *Aviation white*—

“x” is not less than 0.300 and not greater than 0.540;

“y” is not less than “$x-0.040$” or “$y_o-0.010$”, whichever is the smaller; and

“y” is not greater than “$x+0.020$” nor “$0.636-0.400x$”;

Where “y_o” is the “y” coordinate of the Planckian radiator for the value of “x” considered.

§ 27.1399 Riding light.

(a) Each riding light required for water operation must be installed so that it can—

(1) Show a white light for at least two nautical miles at night under clear atmospheric conditions; and

(2) Show a maximum practicable unbroken light with the rotorcraft on the water.

(b) Externally hung lights may be used.

§ 27.1401 Anticollision light system.

(a) *General.* If certification for night operation is requested, the rotorcraft must have an anticollision light system that—

(1) Consists of one or more approved anticollision lights located so that their emitted light will not impair the crew's vision or detract from the conspicuity of the position lights; and

(2) Meets the requirements of paragraphs (b) through (f) of this section.

(b) *Field of coverage.* The system must consist of enough lights to illuminate the vital areas around the rotorcraft, considering the physical configuration and flight characteristics of the rotorcraft. The field of coverage must extend in each direction within at least 30° above and 30° below the horizontal plane of the rotorcraft, except that there may be solid angles of obstructed visibility totaling not more than 0.5 steradians.

(c) *Flashing characteristics.* The arrangement of the system, that is, the number of light sources, beam width, speed of rotation, and other characteristics, must give an effective flash frequency of not less than 40, nor more than 100, cycles per minute. The effective flash frequency is the frequency at which the rotorcraft's complete anticollision light system is observed from a distance, and applies to each sector of light including any overlaps that exist when the system consists of more than one light source. In overlaps, flash frequencies may exceed 100, but not 180, cycles per minute.

(d) *Color*. Each anticollision light must be aviation red and must meet the applicable requirements of § 29.1397.

(e) *Light intensity*. The minimum light intensities in any vertical plane, measured with the red filter (if used) and expressed in terms of "effective" intensities, must meet the requirements of paragraph (f) of this section. The following relation must be assumed:

$$I_e = \frac{\int_{t_1}^{t_2} I(t)\,dt}{0.2 + (t_2 - t_1)};$$

where:

I_e = effective intensity (candles).

$I(t)$ = instantaneous intensity as a function of time.

$t_2 - t_1$ = flash time interval (seconds).

Normally, the maximum value of effective intensity is obtained when t_2 and t_1 are chosen so that the effective intensity is equal to the instantaneous intensity at t_2 and t_1.

(f) *Minimum effective intensities for anticollision light*. Each anticollision light effective intensity must equal or exceed the applicable values in the following table:

Angle above or below the horizontal plane:	*Effective intensity (candles)*
0° to 5°	150
5° to 10°	90
10° to 20°	30
20° to 30°	15

SAFETY EQUIPMENT

§ 27.1411 General.

(a) Required safety equipment to be used by the crew in an emergency, such as flares and automatic liferaft releases, must be readily accessible.

(b) Stowage provisions for required safety equipment must be furnished and must—

(1) Be arranged so that the equipment is directly accessible and its location is obvious; and

(2) Protect the safety equipment from damage caused by being subjected to the inertia loads specified in § 27.561.

§ 27.1413 Safety belts.

[Each safety belt must be equipped with a metal to metal latching device.]

§ 27.1415 Ditching equipment.

(a) Emergency flotation and signaling equipment required by any operating rule in this chapter must meet the requirements of this section.

(b) Each raft and each life preserver must be approved and must be installed so that it is readily available to the crew and passengers. The storage provisions for life preservers must accommodate one life preserver for each occupant for which certification for ditching is requested.

(c) Each raft released automatically or by the pilot must be attached to the rotorcraft by a line to keep it alongside the rotorcraft. This line must be weak enough to break before submerging the empty raft to which it is attached.

(d) Each signaling device must be free from hazard in its operation and must be installed in an accessible location.

§ 27.1419 Ice protection.

(a) To obtain certification for flight into icing conditions, compliance with this section must be shown.

(b) It must be demonstrated that the rotorcraft can be safely operated in the continuous maximum and intermittent maximum icing conditions determined under Appendix C of Part 29 of this chapter within the rotorcraft altitude envelope. An analysis must be performed to establish, on the basis of the rotorcraft's operational needs, the adequacy of the ice protection system for the various components of the rotorcraft.

(c) In addition to the analysis and physical evaluation prescribed in paragraph (b) of this section, the effectiveness of the ice protection system and its components must be shown by flight tests of the rotorcraft or its components in measured atmospheric icing conditions and by one or more of the following tests as found necessary to determine the adequacy of the ice protection system:

(1) Laboratory dry air or simulated icing tests, or a combination of both, of the components or models of the components.

(2) Flight dry air tests of the ice protection system as a whole, or its individual components.

(3) Flight tests of the rotorcraft or its components in measured simulated icing conditions.

(d) The ice protection provisions of this section are considered to be applicable primarily to the airframe. Powerplant installation requirements are contained in Subpart E of this Part.

(e) A means must be identified or provided for determining the formation of ice on critical parts of the rotorcraft. Unless otherwise restricted, the means must be available for nighttime as well as daytime operation. The rotorcraft flight manual must describe the means of determining ice formation and must contain information necessary for safe operation of the rotorcraft in icing conditions.

§ 27.1435 Hydraulic systems.

(a) *Design.* Each hydraulic system and its elements must withstand, without yielding, any structural loads expected in addition to hydraulic loads.

(b) *Tests.* Each system must be substantiated by proof pressure tests. When proof tested, no part of any system may fail, malfunction, or experience a permanent set. The proof load of each system must be at least 1.5 times the maximum operating pressure of that system.

(c) *Accumulators.* No hydraulic accumulator or pressurized reservoir may be installed on the engine side of any firewall unless it is an integral part of an engine.

§ 27.1461 Equipment containing high energy rotors.

(a) Equipment containing high energy rotors must meet paragraph (b), (c), or (d) of this section.

(b) High energy rotors contained in equipment must be able to withstand damage caused by malfunctions, vibration, abnormal speeds, and abnormal temperatures. In addition—

(1) Auxiliary rotor cases must be able to contain damage caused by the failure of high energy rotor blades; and

(2) Equipment control devices, systems, and instrumentation must reasonably ensure that no operating limitations affecting the integrity of high energy rotors will be exceeded in service.

(c) It must be shown by test that equipment containing high energy rotors can contain any failure of a high energy rotor that occurs at the highest speed obtainable with the normal speed control devices inoperative.

(d) Equipment containing high energy rotors must be located where rotor failure will neither endanger the occupants nor adversely affect continued safe flight.

Subpart G—Operating Limitations and Information

§ 27.1501 General.

(a) Each operating limitation specified in §§ 27.1503 through 27.1525 and other limitations and information necessary for safe operation must be established.

(b) The operating limitations and other information necessary for safe operation must be made available to the crewmembers as prescribed in §§ 27.1541 through 27.1589.

OPERATING LIMITATIONS

§ 27.1503 Airspeed limitations: general.

(a) An operating speed range must be established.

(b) When airspeed limitations are a function of weight, weight distribution, altitude, rotor speed, power, or other factors, airspeed limitations corresponding with the critical combinations of these factors must be established.

§ 27.1505 Never-exceed speed.

(a) The never-exceed speed, V_{NE}, must be established so that it is—

(1) Not less than 40 knots (CAS); and

(2) Not more than the lesser of—

[(i) 0.9 times the maximum forward speeds established under § 27.309;

[(ii) 0.9 times the maximum speed shown under §§ 27.251 and 27.629; or

[(iii) 0.9 times the maximum speed substantiated for advancing blade tip mach number effects.]

(b) V_{NE} may vary with altitude, r.p.m., temperature, and weight, if—

(1) No more than two of these variables (or no more than two instruments integrating more than one of these variables) are used at one time; and

(2) The ranges of these variables (or of the indications on instruments integrating more than one of these variables) are large enough to allow an operationally practical and safe variation of V_{NE}.

(c) For helicopters, a stabilized power-off V_{NE} denoted as V_{NE} (power-off) may be established at a speed less than V_{NE} established pursuant to paragraph (a) of this section, if the following conditions are met:

(1) V_{NE} (power-off) is not less than a speed midway between the power-on V_{NE} and the speed used in meeting the requirements of—

(i) § 27.65(b) for single engine helicopters; and

(ii) § 27.67 for multiengine helicopters.

(2) V_{NE}(power-off) is—

(i) A constant airspeed;

(ii) A constant amount less than power-on V_{NE}; or

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(iii) A constant airspeed for a portion of the altitude range for which certification is requested, and a constant amount less than power-on V_{NE} for the remainder of the altitude range.

§ 27.1509 Rotor speed.

(a) *Maximum power off (autorotation).* The maximum power-off rotor speed must be established so that it does not exceed 95 percent of the lesser of—

(1) The maximum design r.p.m. determined under § 27.309(b); and

(2) The maximum r.p.m. shown during the type tests.

(b) *Minimum power off.* The minimum power-off rotor speed must be established so that it is not less than 105 percent of the greater of—

(1) The minimum shown during the type tests; and

(2) The minimum determined by design substantiation.

(c) *Minimum power on.* The minimum power-on rotor speed must be established so that it is—

(1) Not less than the greater of—

(i) The minimum shown during the type tests; and

(ii) The minimum determined by design substantiation; and

(2) Not more than a value determined under § 27.33(a) (1) and (b) (1).

§ 27.1519 Weight and center of gravity.

[The weight and center of gravity limitations determined under §§ 27.25 and 27.27, respectively, must be established as operating limitations.]

§ 27.1521 Powerplant limitations.

(a) *General.* The powerplant limitations prescribed in this section must be established so that they do not exceed the corresponding limits for which the engines are type certificated.

(b) *Takeoff operation.* The powerplant takeoff operation must be limited by—

(1) The maximum rotational speed, which may not be greater than—

(i) The maximum value determined by the rotor design; or

(ii) The maximum value shown during the type tests;

(2) The maximum allowable manifold pressure (for reciprocating engines);

(3) The time limit for the use of the power corresponding to the limitations established in subparagraphs (1) and (2) of this paragraph;

(4) If the time limit in subparagraph (3) of this paragraph exceeds two minutes, the maximum allowable cylinder head, coolant outlet, or oil temperatures;

(5) The gas temperature limits for turbine engines over the range of operating and atmospheric conditions for which certification is requested.

(c) *Continuous operation.* The continuous operation must be limited by—

(1) The maximum rotational speed, which may not be greater than—

(i) The maximum value determined by the rotor design; or

(ii) The maximum value shown during the type tests;

(2) The minimum rotational speed shown under the rotor speed requirements in § 27.1509(c); and

(3) The gas temperature limits for turbine engines over the range of operating and atmospheric conditions for which certification is requested.

(d) *Fuel grade or designation.* The minimum fuel grade (for reciprocating engines), or fuel designation (for turbine engines), must be established so that it is not less than that required for the operation of the engines within the limitations in paragraphs (b) and (c) of this section.

(e) *Turboshaft engine torque.* For rotorcraft with main rotors driven by turboshaft engines, and that do not have a torque limiting device in the transmission system, the following apply:

(1) A limit engine torque must be established if the maximum torque that the engine can exert is greater than—

(i) The torque that the rotor drive system is designed to transmit; or

(ii) The torque that the main rotor assembly is designed to withstand in showing compliance with § 27.547(e).

(2) The limit engine torque established under subparagraph (1) of this paragraph may not exceed either torque specified in subdivision (1) (i) or (ii) of this paragraph.

(f) *Ambient temperature.* For turbine engines, ambient temperature limitations (including limitations for winterization installations, if applicable) must be established as the maximum ambient atmospheric temperature at which compliance with the cooling provisions of §§ 27.1041 through 27.1045 is shown.

§ 27.1523 Minimum flight crew.

The minimum flight crew must be established so that it is sufficient for safe operation, considering—

(a) The workload on individual crewmembers;

(b) The accessibility and ease of operation of necessary controls by the appropriate crewmember; and

(c) The kinds of operation authorized under § 27.1525.

§ 27.1525 Kinds of operation.

[The kinds of operations (such as VFR, IFR, day, night, or icing) for which the rotorcraft is approved are established by demonstrated compliance with the applicable requirements and by the installed equipment.]

§ 27.1527 Maximum operating altitude.

The maximum altitude up to which operation is allowed, as limited by flight, structural, powerplant, functional; or equipment characteristics, must be established.

§ 27.1529 Instructions for Continued Airworthiness.

The applicant must prepare Instructions for Continued Airworthiness in accordance with Appendix A to this Part that are acceptable to the Administrator. The instructions may be incomplete at type certification if a program exists to ensure their completion prior to delivery of the first rotorcraft or issuance of a standard certificate of airworthiness, whichever occurs later.

MARKINGS AND PLACARDS

§ 27.1541 General.

(a) The rotorcraft must contain—

(1) The markings and placards specified in §§ 27.1545 through 27.1565, and

(2) Any additional information, instrument markings, and placards required for the safe operation of rotorcraft with unusual design, operating or handling characteristics.

(b) Each marking and placard prescribed in paragraph (a) of this section—

(1) Must be displayed in a conspicuous place; and

(2) May not be easily erased, disfigured, or obscured.

§ 27.1543 Instrument markings: general.

For each instrument—

(a) When markings are on the cover glass of the instrument, there must be means to maintain the correct alignment of the glass cover with the face of the dial; and

(b) Each arc and line must be wide enough, and located, to be clearly visible to the pilot.

§ 27.1545 Airspeed indicator.

(a) Each airspeed indicator must be marked as specified in paragraph (b) of this section, with the marks located at the corresponding indicated airspeeds.

(b) The following markings must be made:

(1) A red radial line—

(i) For rotorcraft other than helicopters, at V_{NE}; and

(ii) For helicopters, at V_{NE} (power-on).

(2) A red, cross-hatched radial line at V_{NE} (power-off) for helicopters, if V_{NE} (power-off) is less than V_{NE} (power-on).

(3) For the caution range, a yellow arc.

(4) For the safe operating range, a green arc.

§ 27.1547 Magnetic direction indicator.

(a) A placard meeting the requirements of this section must be installed on or near the magnetic direction indicator.

(b) The placard must show the calibration of the instrument in level flight with the engines operating.

(c) The placard must state whether the calibration was made with radio receivers on or off.

(d) Each calibration reading must be in terms of magnetic heading in not more than 45° increments.

(e) If a magnetic nonstabilized direction indicator can have a deviation of more than 10 degrees caused by the operation of electrical equipment, the placard must state which electrical loads, or combination of loads, would cause a deviation of more than 10 degrees when turned on.

§ 27.1549. Powerplant instruments.

For each required powerplant instrument, as appropriate to the type of instrument—

(a) Each maximum and, if applicable, minimum safe operating limit must be marked with a red radial or a red line;

(b) Each normal operating range must be marked with a green arc or green line, not extending beyond the maximum and minimum safe limits;

(c) Each takeoff and precautionary range must be marked with a yellow arc or yellow line; and

(d) Each engine or propeller range that is restricted because of excessive vibration stresses must be marked with red arc or red lines.

§ 27.1551 Oil quantity indicator.

Each oil quantity indicator must be marked with enough increments to indicate readily and accurately the quantity of oil.

§ 27.1553 Fuel quantity indicator.

If the unusable fuel supply for any tank exceeds one gallon, or five percent of the tank capacity, whichever is greater, a red arc must be marked on its indicator extending from the calibrated zero reading to the lowest reading obtainable in level flight.

§ 27.1555 Control markings.

[(a) Each cockpit control, other than primary flight controls or control whose function is obvious, must be plainly marked as to its function and method of operation.]

(b) For powerplant fuel controls—

(1) Each fuel tank selector control must be marked to indicate the position corresponding to each tank and to each existing cross feed position;

(2) If safe operation requires the use of any tanks in a specific sequence, that sequence must be marked on, or adjacent to, the selector for those tanks; and

(3) Each valve control for any engine of a multiengine rotorcraft must be marked to indicate the position corresponding to each engine controlled.

(c) Usable fuel capacity must be marked as follows:

(1) For fuel systems having no selector controls, the usable fuel capacity of the system must be indicated at the fuel quantity indicator.

(2) For fuel systems having selector controls, the usable fuel capacity available at each selector control position must be indicated near the selector control.

(d) For accessory, auxiliary, and emergency controls—

(1) Each essential visual position indicator, such as those showing rotor pitch or landing gear position, must be marked so that each crewmember can determine at any time the position of the unit to which it relates; and

(2) Each emergency control must be red and must be marked as to method of operation.

[(e) For rotorcraft incorporating retractable landing gear, the maximum landing gear operating speed must be displayed in clear view of the pilot.]

§ 27.1557 Miscellaneous markings and placards.

(a) *Baggage and cargo compartments, and ballast location.* Each baggage and cargo compartment, and each ballast location must have a placard stating any limitations on contents, including weight, that are necessary under the loading requirements.

(b) *Seats.* If the maximum allowable weight to be carried in a seat is less than 170 pounds, a placard stating the lesser weight must be permanently attached to the seat structure.

(c) *Fuel and oil filler openings.*The following apply:

(1) Fuel filler openings must be marked at or near the filler cover with—

(i) The word "fuel";

(ii) For reciprocating engine powered rotorcraft, the minimum fuel grade;

(iii) For turbine engine powered rotorcraft, the permissible fuel designations; and

(iv) For pressure fueling systems, the maximum permissible fueling supply pressure and the maximum permissible defueling pressure.

(2) Oil filler openings must be marked at or near the filler cover with the word "oil".

(d) *Emergency exit placards.*Each placard and operating control for each emergency exit must be red. A placard must be near each emergency exit control and must clearly indicate the location of that exit and its method of operation.

§ 27.1559 Limitations placard.

[There must be a placard in clear view of the pilot that specifies the kinds of operations (such as VFR, IFR, day, night, or icing) for which the rotorcraft is approved.]

§ 27.1561 Safety equipment.

(a) Each safety equipment control to be operated by the crew in emergency, such as controls for automatic liferaft releases, must be plainly marked as to its method of operation.

(b) Each location, such as a locker or compartment, that carries any fire extinguishing, signaling, or other life saving equipment, must be so marked.

§ 27.1565 Tail rotor.

Each tail rotor must be marked so that its disc is conspicuous under normal daylight ground conditions.

ROTORCRAFT FLIGHT MANUAL AND APPROVED MANUAL MATERIAL

§ 27.1581 General.

(a) *Furnishing information.* A Rotorcraft Flight Manual must be furnished with each rotorcraft, and it must contain the following:

(1) Information required by §§ 27.1583 through 27.1589.

(2) Other information that is necessary for safe operation because of design, operating, or handling characteristics.

(b) *Approved information.* Each part of the manual listed in §§ 27.1583 through 27.1589, that is appropriate to the rotorcraft, must be furnished, verified, and approved, and must be segregated, identified, and clearly distinguished from each unapproved part of that manual.

(c) [Reserved]

(d) *Table of contents.* Each Rotorcraft Flight Manual must include a table of contents if the complexity of the manual indicates a need for it.

§ 27.1583 Operating limitations.

(a) *Airspeed and rotor limitations.* Information necessary for the marking of airspeed and rotor limitations on, or near, their respective indicators must be furnished. The significance of each limitation and of the color coding must be explained.

(b) *Powerplant limitations.* The following information must be furnished:

(1) Limitations required by § 27.1521.

(2) Explanation of the limitations, when appropriate.

(3) Information necessary for marking the instruments required by §§ 27.1549 through 27.1553.

(c) *Weight and loading distribution.* The weight and center of gravity limits required by §§ 27.25 and 27.27, respectively, must be furnished. If the variety of possible loading conditions warrants, instructions must be included to allow ready observation of the limitations.

(d) *Flight crew.* When a flight crew of more than one is required, the number and functions of the minimum flight crew determined under § 27.1523 must be furnished.

(e) *Kinds of operation.* Each kind of operation for which the rotorcraft and its equipment installations are approved must be listed.

(f) [Reserved]

(g) *Altitude.* The altitude established under § 27.1527 and an explanation of the limiting factors must be furnished.

§ 27.1585 Operating procedures.

[(a) Parts of the manual containing operating procedures must have information concerning any normal and emergency procedures and other information necessary for safe operation, including takeoff and landing procedures and associated airspeeds. The manual must contain any pertinent information including—

[(1) The kind of takeoff surface used in the tests and each appropriate climbout speed; and

[(2) The kind of landing surface used in the tests and appropriate approach and glide airspeeds.]

(b) For multiengine rotorcraft, information identifying each operating condition in which the fuel system independence prescribed in § 27.953 is necessary for safety must be furnished, together with instructions for placing the fuel system in a configuration used to show compliance with that section.

(c) For helicopters for which a V_{NE} (power-off) is established under § 27.1505(c), information must be funished to explain the V_{NE} (power-off) and the procedures for reducing airspeed to not more than the V_{NE} (power-off) following failure of all engines.

(d) For each rotorcraft showing compliance with § 27.1353(g)(2) or (g)(3), the operating procedures for disconnecting the battery from its charging source must be furnished.

(e) If the unusable fuel supply in any tank exceeds five percent of the tank capacity, or one gallon, whichever is greater, information must be furnished which indicates that when the fuel quantity indicator reads "zero" in level flight, any fuel remaining in the fuel tank cannot be used safely in flight.

(f) Information on the total quantity of usable fuel for each fuel tank must be furnished.

[(g) The airspeeds and rotor speeds for minimum rate of descent and best glide angle as prescribed in § 27.71 must be provided.]

§ 27.1587 Performance information.

(a) The rotorcraft must be furnished with the following information, determined in accordance with §§ 27.51 through 27.79 and 27.143(c):

(1) Enough information to determine the limiting height-speed envelope.

(2) Information relative to—

(i) The hovering ceilings and the steady rates of climb and descent, as affected by any pertinent factors such as airspeed, temperature, and altitude;

[(ii) The maximum safe wind for operation near the ground. If there are combinations of weight, altitude, and temperature for which performance information is provided and at which the rotorcraft cannot land and takeoff safely with the maximum wind value, those portions of the operating envelope and the appropriate safe wind conditions shall be identified in the flight manual;

[(iii) For reciprocating engine-powered rotorcraft, the maximum atmospheric temperature at which compliance with the cooling provisions of §§ 27.1041 through 27.1045 is shown; and

[(iv) Glide distance as a function of altitude when autorotating at the speeds and conditions for minimum rate of descent and best glide as determined in § 27.71.]

(b) The Rotorcraft Flight Manual must contain—

[(1) In its performance information section any pertinent information concerning the takeoff weights and altitudes used in compliance with § 27.51; and

[(2) The horizontal takeoff distance determined in accordance with § 27.65(a)(2)(i).]

§ 27.1589 Loading information.

There must be loading instructions for each possible loading condition between the maximum and minimum weights determined under § 27.25 that can result in a center of gravity beyond any extreme prescribed in § 27.27, assuming any probable occupant weights.

[Appendix A

[Instructions For Continued Airworthiness

[A27.1 *General.*

[(a) This appendix specifies requirements for the preparation of Instructions for Continued Airworthiness as required by § 27.1529.

[(b) The Instructions for Continued Airworthiness for each rotorcraft must include the Instructions for Continued Airworthiness for each engine and rotor (hereinafter designated 'products'), for each appliance required by this chapter, and any required information relating to the interface of those appliances and products with the rotorcraft. If Instructions for Continued Airworthiness are not supplied by the manufacturer of an appliance or product installed in the rotorcraft, the Instructions for Continued Airworthiness for the rotorcraft must include the information essential to the continued airworthiness of the rotorcraft.

[(c) The applicant must submit to the FAA a program to show how changes to the Instructions for Continued Airworthiness made by the applicant or by the manufacturers of products and appliances installed in the rotorcraft will be distributed.

[A27.2 *Format.*

[(a) The Instructions for Continued Airworthiness must be in the form of a manual or manuals as appropriate for the quantity of data to be provided.

[(b) The format of the manual or manuals must provide for a practical arrangement.

[A27.3 *Content.*

[The contents of the manual or manuals must be prepared in the English language. The Instructions for Continued Airworthiness must contain the following manuals or sections, as appropriate, and information:

[(a) *Rotorcraft maintenance manual or section.*

[(1) Introduction information that includes an explanation of the rotorcraft's features and data to the extent necessary for maintenance or preventive maintenance.

[(2) A description of the rotorcraft and its systems and installations including its engines, rotors, and appliances.

[(3) Basic control and operation information describing how the rotorcraft components and systems are controlled and how they operate, including any special procedures and limitations that apply.

[(4) Servicing information that covers details regarding servicing points, capacities of tanks, reservoirs, types of fluids to be used, pressures applicable to the various systems, location of access panels for inspection and servicing, locations of lubrication points, lubricants to be used, equipment required for servicing, tow instructions and limitations, mooring, jacking, and leveling information.

[(b) *Maintenance Instructions.*

[(1) Scheduling information for each part of the rotorcraft and its engines, auxiliary power units, rotors, accessories, instruments, and equipment that provides the recommended periods at which they should be cleaned, inspected, adjusted, tested, and lubricated, and the degree of inspection, the applicable wear tolerances, and work recommended at these periods. However, the applicant may refer to an accessory, instrument, or equipment manufacturer as the source of this information if the applicant shows that the item has an exceptionally high degree of complexity requiring specialized maintenance techniques, test equipment, or expertise. The recommended overhaul periods and necessary cross reference to the Airworthiness Limitations section of the manual must also be included. In addition, the applicant must include an inspection program that includes the frequency and extent of the inspections necessary to provide for the continued airworthiness of the rotorcraft.

[(2) Troubleshooting information describing probable malfunctions, how to recognize those malfunctions, and the remedial action for those malfunctions.

[(3) Information describing the order and method of removing and replacing products and parts with any necessary precautions to be taken.

[(4) Other general procedural instructions including procedures for system testing during ground running, symmetry checks, weighing and determining the center of gravity, lifting and shoring, and storage limitations.

[(c) Diagrams of structural access plates and information needed to gain access for inspections when access plates are not provided.

[(d) Details for the application of special inspection techniques including radiographic and ultrasonic testing where such processes are specified.

[(e) Information needed to apply protective treatments to the structure after inspection.

[(f) All data relative to structural fasteners such as identification, discard recommendations, and torque values.

[(g) A list of special tools needed.

[A27.4 *Airworthiness Limitations section.*

[The Instructions for Continued Airworthiness must contain a section titled Airworthiness Limitations that is segregated and clearly distinguishable from the rest of the document. This section must set forth each mandatory replacement time, structural inspection interval, and related structural inspection procedure approved under § 27.571. If the Instructions for Continued Airworthiness consist of multiple documents, the section required by this paragraph must be included in the principal manual. This section must contain a legible statement in a prominent location that reads: "The Airworthiness Limitations section is FAA approved and specifies maintenance required under §§ 43.16 and 91.163 of the Federal Aviation Regulations unless an alternative program has been FAA approved."]

[Appendix B

[Airworthiness Criteria for Helicopter Instrument Flight

[I. *General.* A normal category helicopter may not be type certificated for operation under the instrument flight rules (IFR) of this chapter unless it meets the design and installation requirements contained in this Appendix.

II. *Definitions.* (a) V_{YI} means instrument climb speed, utilized instead of V_Y for compliance with the climb requirements for instrument flight.

(b) V_{NEI} means instrument flight never exceed speed, utilized instead of V_{NE} for compliance with maximum limit speed requirements for instrument flight.

(c) V_{MINI} means instrument flight minimum speed, utilized in complying with minimum limit speed requirements for instrument flight.

III. *Trim.* It must be possible to trim the cyclic, collective, and directional control forces to zero at all approved IFR airspeeds, power settings, and configurations appropriate to the type.

IV. *Static longitudinal stability.* (a) *General.* The helicopter must possess positive static longitudinal control force stability at critical combinations of weight and center of gravity at the conditions specified in paragraph IV(b) or (c) of this Appendix, as appropriate. The stick force must vary with speed so that any substantial speed change results in a stick force clearly perceptible to the pilot. For single-pilot approval, the airspeed must return to within 10 percent of the trim speed when the control force is slowly released for each trim condition specified in paragraph IV(b) of this Appendix.

(b) *For single-pilot approval:*

(1) *Climb.* Stability must be shown in climb throughout the speed range 20 knots either side of trim with—

(i) The helicopter trimmed at V_{YI};

(ii) Landing gear retracted (if retractable); and

(iii) Power required for limit climb rate (at least 1,000 fpm) at V_{YI} or maximum continuous power, whichever is less.

(2) *Cruise.* Stability must be shown throughout the speed range from 0.7 to 1.1 V_H or V_{NEI}, whichever is lower, not to exceed ±20 knots from trim with—

(i) The helicopter trimmed and power adjusted for level flight at 0.9 V_H or 0.9 V_{NEI}, whichever is lower and

(ii) Landing gear retracted (if retractable).

(3) *Slow cruise.* Stability must be shown throughout the speed range from 0.9 V_{MINI} to 1.3 V_{MINI} or 20 knots above trim speed, whichever is greater, with—

(i) The helicopter trimmed and power adjusted for level flight at 1.1 V_{MINI}; and

(ii) Landing gear retracted (if retractable).

(4) *Descent.* Stability must be shown throughout the speed range 20 knots either side of trim with—

(i) The helicopter trimmed at 0.8 V_H or 0.8 V_{NEI} (or 0.8 V_{LE} for the landing gear extended case), whichever is lower;

(ii) Power required for 1,000 fpm descent at trim speed; and

(iii) Landing gear extended and retracted, if applicable.

(5) *Approach.* Stability must be shown throughout the speed range from 0.7 times the minimum recommended approach speed to 20 knots above the maximum recommended approach speed with—]

[(i) The helicopter trimmed at the recommended approach speed or speeds;

(ii) Landing gear extended and retracted, if applicable; and

(iii) Power required to maintain a 3° glide path and power required to maintain the steepest approach gradient for which approval is requested.

(c) Helicopters approved for a minimum crew of two pilots must comply with the provisions of paragraphs IV(b) (2) and IV(b) (5) of this Appendix.

V. *Static lateral-directional stability.* (a) Static directional stability must be positive throughout the approved ranges of airspeed, power, and vertical speed. In straight, steady sideslips up to ±10° from trim, directional control position must increase in approximately constant proportion to angle of sideslip. At greater angles up to the maximum sideslip angle appropriate to the type, increased directional control position must produce increased angle of sideslip.

(b) During sideslips up to ±10° from trim throughout the approved ranges of airspeed, power, and vertical speed, there must be no negative dihedral stability perceptible to the pilot through lateral control motion or force. Longitudinal cyclic movement with sideslip must not be excessive.

VI. *Dynamic stability.* (a) For single-pilot approval—

(1) Any oscillation having a period of less than 5 seconds must damp to ½ amplitude in not more than one cycle.

(2) Any oscillation having a period of 5 seconds or more but less than 10 seconds must damp to ½ amplitude in not more than two cycles.

(3) Any oscillation having a period of 10 seconds or more but less than 20 seconds must be damped.

(4) Any oscillation having a period of 20 seconds or more may not achieve double amplitude in less than 20 seconds.

(5) Any aperiodic response may not achieve double amplitude in less than 6 seconds.

(b) For helicopters approved with a minimum crew of two pilots—

(1) Any oscillation having a period of less than 5 seconds must damp to ½ amplitude in not more than two cycles.

(2) Any oscillation having a period of 5 seconds or more but less than 10 seconds must be damped.

(3) Any oscillation having a period of 10 seconds or more may not achieve double amplitude in less than 10 seconds.

VII. *Stability augmentation system (SAS).* (a) If a SAS is used, the reliability of the SAS must be related to the effects of its failure. The occurrence of any failure condition which would prevent continued safe flight and landing must be extremely improbable. For any failure condition of the SAS which is not shown to be extremely improbable—

(1) The helicopter must be safely controllable and capable of prolonged instrument flight without undue pilot effort. Additional unrelated probable failures affecting the control system must be considered; and

(2) The flight characteristics requirements in Subpart B of Part 27 must be met throughout a practical flight envelope.

(b) The SAS must be designed so that it cannot create a hazardous deviation in flight path or produce hazardous loads on the helicopter during normal operation or in the event of malfunction or failure, assuming corrective action begins within an appropriate period of time. Where multiple systems are installed, subsequent malfunction conditions must be considered in sequence unless their occurrence is shown to be improbable.

VIII. *Equipment, systems, and installation.* The basic equipment and installation must comply with §§ 29.1303, 29.1431, and 29.1433 through Amendment 29–14, with the following exceptions and additions:

(a) *Flight and Navigation Instruments.* (1) A magnetic gyro-stabilized direction indicator instead of a gyroscopic direction indicator required by § 29.1303(h); and

(2) A standby attitude indicator which meets the requirements of §§ 29.1303(g) (1) through (7) instead of a rate-of-turn indicator required by § 29.1303(g). For two-pilot con-]

[figurations, one pilot's primary indicator may be designed for this purpose. If standby batteries are provided, they may be charged from the aircraft electrical system if adequate isolation is incorporated.

(b) *Miscellaneous requirements.* (1) Instrument systems and other systems essential for IFR flight that could be adversely affected by icing must be adequately protected when exposed to the continuous and intermittent maximum icing conditions defined in Appendix C of Part 29 of this chapter, whether or not the rotorcraft is certificated for operation in icing conditions.

(2) There must be means in the generating system to automatically de-energize and disconnect from the main bus any power source developing hazardous overvoltage.

(3) Each required flight instrument using a power supply (electric, vacuum, etc.) must have a visual means integral with the instrument to indicate the adequacy of the power being supplied.

(4) When multiple systems performing like functions are required, each system must be grouped, routed, and spaced so that physical separation between systems is provided to ensure that a single malfunction will not adversely affect more than one system.

(5) For systems that operate the required flight instruments at each pilot's station—

(i) Only the required flight instruments for the first pilot may be connected to that operating system;

(ii) Additional instruments, systems, or equipment may not be connected to an operating system for a second pilot unless provisions are made to ensure the continued normal functioning of the required instruments in the event of any malfunction of the additional instruments, systems, or equipment which is not shown to be extremely improbable;

(iii) The equipment, systems, and installations must be designed so that one display of the information essential to the safety of flight which is provided by the instruments will remain available to a pilot, without additional crewmember action, after any single failure or combination of failures that is not shown to be extremely improbable; and

(iv) For single-pilot configurations, instruments which require a static source must be provided with a means of selecting an alternate source and that source must be calibrated.

IX. *Rotorcraft Flight Manual.* A Rotorcraft Flight Manual or Rotorcraft Flight Manual IFR Supplement must be provided and must contain—

(a) *Limitations.* The approved IFR flight envelope, the IFR flightcrew composition, the revised kinds of operation, and the steepest IFR precision approach gradient for which the helicopter is approved;

(b) *Procedures.* Required information for proper operation of IFR systems and the recommended procedures in the event of stability augmentation or electrical system failures; and

(c) *Performance.* If V_{YI} differs from V_Y, climb performance at V_{YI} and with maximum continuous power throughout the ranges of weight, altitude, and temperature for which approval is requested.]

[illegible]

[illegible]

Special Federal Aviation Regulation 29-2

FAA Study of Limited IFR Operations in Rotorcraft

Adopted: January, 3, 1979 **Effective: January 3, 1979**

(Published in 44 FR 2362, January 11, 1979)

SUMMARY: This amendment reissues a special regulation which allows for limited operations under instrument flight rules (IFR) of certain transport category rotorcraft that are limited by their type certificates to operations under visual flight rules (VFR). It also amends the provisions of the special regulation by including Part 27 rotorcraft operations and deleting the airspace restrictions. The amendment is necessary to provide time for further study to determine whether the airworthiness requirements should be revised.

FOR FURTHER INFORMATION CONTACT:

Mr. Donald A. Schroeder, Safety Regulations Division, Flight Standards Service, Federal Aviation Administration, 800 Independence Avenue, S.W., Washington, D.C. 20591; Telephone 202-755-8715.

SUPPLEMENTAL INFORMATION: Under Part 27 or 29 of the Federal Aviation Regulations (FAR) a rotorcraft is certificated for VFR operation only, unless it has been shown that the rotorcraft fully complies with all of the airworthiness requirements for IFR operations. The FAA believes that certain IFR operations can be safely conducted with rotorcraft that do not meet all of the present flight characteristic requirements. Special Federal Aviation Regulation (SFAR) No. 29 was adopted to provide for the issue by the Administrator of approvals for this relief on an interim basis pending the conclusion of a study to determine whether a "limited" IFR category should be established for these rotorcraft, including flight characteristics and equipment requirements, operating procedures and limitations, flight crew requirements, and training requirements. The expiration date of SFAR No. 29 as amended by SFAR No. 29-1 (41 FR 1060), is December 31, 1978.

The FAA has established a Rotorcraft Regulatory Review Program which will involve a comprehensive review and upgrading of rules regarding rotorcraft airworthiness standards and operating requirements. This program will consider the development of IFR airworthiness standards for rotorcraft certification in Parts 27 and 29 of the FAR. This program will not be concluded by the December 31, 1978, termination date of SFAR No. 29.

The FAA has been requested by the Helicopter Association of America on behalf of their membership to consider including certain helicopters certificated to the airworthiness standards of Part 27 to allow IFR operations similar to those conducted under SFAR 29. In addition, it was requested that the airspace restrictions be deleted. Based upon the study results to date and the need to collect additional data, the FAA has determined that the requirement for specific approval of IFR routes and area of operation could be deleted without jeopardizing safety. The present IFR study provisions of SFAR 29 have not included Part 27 helicopters which are being used in pilot training programs leading towards instrument ratings in rotorcraft-helicopters. In addition, a number of these helicopters, operating VFR, presently require, under the interim standards for IFR certification, stringent and costly stability augmentation devices to be added to the flight control system before operating in instrument meteorological conditions. The need exists to expand the IFR study to include certain helicopters certificated to the airworthiness standards of Part 27 and evaluate the need for stability devices prior to imposing a large financial burden upon the industry.

In a continued effort to expand the data base of operational information, the FAA has, therefore, determined it advisable to amend SFAR 29 to delete the airspace restrictions and to include certain helicopters certificated to the airworthiness standards of Part 27.

If SFAR No. 29 were not to continue in effect until the completion of the rulemaking action generated by the Rotorcraft Regulatory Review Program, an undue burden could be placed on certain operators of helicopters meeting the criteria specified in SFAR No. 29 because it would prohibit IFR operations with those helicopters which might be allowed when the Rotorcraft Regulatory Review Program is completed. Thus, the FAA believes that it is in the public interest to allow IFR operations with certain rotorcraft that do not meet all of the present requirements of Parts 21, 27, 29, and 91 of the FAR pending a determination of whether or not new standards should be developed.

The expansion and effectivity of SFAR No. 29 to December 31, 1980, should provide the FAA sufficient time to determine what regulatory changes are necessary.

ADOPTION OF THE AMENDMENT

Since this amendment temporarily relieves a restriction in connection with operations conducted as part of an FAA study and imposes no additional burden on any person, I find that notice and public procedure are unnecessary and that good cause exists for making this amendment effective in less than 30 days.

Accordingly, Special Federal Aviation Regulation No. 29, as amended by SFAR No. 29-1, is reissued, effective January 3, 1979.

Sections 313(a), 601(a), and 603 of the Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421(a), and 1423) and section 6(c) of the Department of Transportation Act (49 U.S.C. 1655(c)).)

The Federal Aviation Administration has determined that this document is not significant in accordance with the criteria required by Executive Order 12044, and set forth in the proposed "Department of Transportation Regulatory Policies and Procedures" published in the FEDERAL REGISTER June 1, 1978 (43 FR 23925).

Special Federal Aviation Regulation 29-3

Limited IFR Operations in Rotorcraft

Adopted: October 21, 1980 **Effective: January 1, 1981**

(Published in 45 FR 71919, October 30, 1980)

SUMMARY: This amendment extends the effectivity of Special Federal Aviation Regulation No. 29-2 which allows for limited operations under instrument flight rules (IFR) for certain normal and transport category rotorcraft that are limited by their type certificates to operations under visual flight rules (VFR). The extension is necessary to provide time for further study to determine whether the airworthiness requirements should be revised.

FOR FURTHER INFORMATION CONTACT: Mr. Roger E. Riviere, Regulatory Review Branch (AVS-22), Safety Regulations Staff, Associate Administrator for Aviation Standards, Federal Aviation Administration, 800 Independence Ave. S.W., Washington, D.C. 20591, telephone (202) 755-8714.

SUPPLEMENTAL INFORMATION: Under Part 27 or 29 of the Federal Aviation Regulations (FAR) a rotorcraft is certificated for visual flight rules (VFR) operation only, unless it is shown that the rotorcraft fully complies with all of the airworthiness requirements for IFR operations. Certain IFR operations can be safely conducted with rotorcraft that do not meet all of the present flight characteristic requirements. Special Federal Aviation Regulation (SFAR) No. 29 was adopted to allow the Administrator to issue approvals for these operations on an interim basis pending the conclusion of a study to determine whether a "limited" IFR category should be established for these rotorcraft, including flight characteristics and equipment requirements, operating procedures and limitations, flightcrew requirements, and training requirements. SFAR No. 29, as amended by SFAR No. 29-2 (44 FR 2362), expires December 31, 1980.

The FAA has established a Rotorcraft Regulatory Review Program which involves a comprehensive review and upgrading of rules regarding rotorcraft airworthiness standards and operating requirements. This program will consider the development of IFR airworthiness standards for rotorcraft certification in Parts 27 and 29 of the FAR. It is the intent of the FAA to rescind this SFAR upon adoption of the new rotorcraft IFR certification standards in Parts 27 and 29 as part of the Rotorcraft Regulatory Review Program. This program will not be concluded by the December 31, 1980, termination date of SFAR No. 29 as amended. If the SFAR expires before the completion of the rulemaking action generated by the program, an undue burden could be placed on certain operators of helicopters meeting the criteria specified in the SFAR because it would prohibit IFR operations with those helicopters which might be allowed when the Rotorcraft Regulatory Review Program is completed. This is consistent with Executive Order 12044 issued by President Carter in that it minimizes compliance costs and burdens on the public. Results have not shown any adverse safety effect during the time that it was in effect and none are expected in the future should this SFAR be extended. Thus, the FAA has determined that it is in the public interest to extend the effectivity of SFAR 29, as amended, pending a determination of whether or not new standards should be developed.

ADOPTION OF THE AMENDMENT

Since this amendment temporarily relieves a restriction in connection with operations conducted as part of an FAA study and imposes no additional burden on any person, I find that notice and public procedure are unnecessary.

Accordingly, Special Federal Aviation Regulation No. 29, as amended by SFAR No. 29-2, is reissued, effective January 1, 1981.

Sections 313(a), 601(a), and 603 of the Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421(a), and 1423) and section 6(c) of the Department of Transportation Act (49 U.S.C. 1655(c)).)

The Federal Aviation Administration has determined that this document is not significant in accordance with the criteria required by Executive Order 12044, as implemented by the Department of Transportation Regulatory Policies and Procedures (44 FR 11034; Fedruary 26, 1979).

Special Federal Aviation Regulation 29-4
Limited IFR Operations of Rotorcraft

Adopted: December 28, 1982 **Effective: January 1, 1983**

(Published in 48 FR 631, January 6, 1983)

SUMMARY: This amendment extends the effectivity of Special Federal Aviation Regulation (SFAR) No. 29-3, which allows limited operations under instrument flight rules (IFR) of certain normal and transport category rotorcraft that are limited by their type certificates to operations under visual flight rules (VFR). The extension is necessary to prevent imposing any economic burden upon those operators already authorized, equipped, and qualified to conduct operations under SFAR No. 29, which would occur if SFAR 29-3 were permitted to terminate before Amendment No. 1 of the Rotorcraft Regulatory Review Program is issued and effective.

FOR FURTHER INFORMATION CONTACT: Mike Sacrey or Win Karish; Operations Branch (AFO-820); General Aviation & Commercial Division; Office of Flight Operations; Federal Aviation Administration; 800 Independence Ave., SW.; Washington. D.C. 20591; telephone (202) 426-8194.

SUPPLEMENTARY INFORMATION:

Background

Under Part 27 or Part 29 of the Federal Aviation Regulations (FAR), a rotorcraft is certificated for VFR operation only, unless it has been shown that the rotorcraft fully complies with all of the airworthiness requirements for instrument flight rules (IFR) operations. Since certain IFR operations can be safely conducted with rotorcraft that do not meet all of the present flight characteristic requirements, SFAR No. 29 was adopted by the Administrator on January 3, 1975 (40 FR 2420; January 13, 1975). SFAR No. 29 allowed the Administrator to issue approvals for such operators, on an interim basis, pending the conclusion of a study to determine whether a "limited" IFR category should be established for these rotorcraft, including flight characteristics and equipment requirements, operating procedures and limitations, flightcrew requirements, and training requirements. The expiration date of SFAR No. 29, as amended by SFAR No. 29-3 (45 FR 71919; October 30, 1980), is December 31, 1982.

The FAA has established a Rotorcraft Regulatory Review Program which will involve a comprehensive review and upgrading of requirements. This program will consider the development of IFR airworthiness standards for rotorcraft certification in Parts 27 and 29 of the FAR. It will not be concluded by the December 31, 1982, termination date of SFAR No. 29-3.

Discussion

If SFAR No. 29 were to expire before completing the rulemaking action generated by the Rotorcraft Regulatory Review Program, there would be no regulatory basis to allow continued IFR rotorcraft operations, thereby creating an undue burden for those operators of helicopters meeting the criteria specified in SFAR No. 29.

Pending the issuance and effectivity of new standards to be established by Amendment No. 1 of the Rotorcraft Regulatory Review Program, the FAA believes that it is in the public interest to allow continued IFR operations with certain rotorcraft that do not meet all of the present requirements of Parts 21, 27, 29, and 91 of the FAR. With the issuance of SFAR No. 29-4, operators may continue to apply for SFAR 29 approvals until Amendment No. 1 of the Rotorcraft Regulatory Review Program (Amendment No. 1) is effective. After Amendment No. 1 is effective, all applicants for certification of IFR rotorcraft operations will have to comply with the applicable provisions of that amendment. When Amendment No. 1 becomes effective, SFAR No. 29-4 (and approvals issued under SFAR Nos. 29 through 29-4) will remain effective for operators holding approvals obtained before the effective date of Amendment No. 1. SFAR 29-4 will terminate when all approvals issued under SFAR Nos. 29 through 29-4 are surrendered, revoked, or otherwise terminated.

Need for Immediate Adoption

Since this amendment temporarily extends the effectivity of a rule which permits continued IFR rotorcraft operations by operators equipped and qualified to comply with Special Federal Aviation Regulation No. 29 and therefore imposes no additional burden on any person, I find that notice and public procedure are unnecessary and that good cause exists for making this amendment effective in less than 30 days.

THE AMENDMENT

Accordingly, Special Federal Aviation Regulation No. 29, as amended by Special Federal Aviation Regulation No. 29-3 (14 CFR Parts 21, 27, 29, and 91), is reissued and amended, effective January 1, 1983.

(Sections 313(a), 601(a), and 603 of the Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421(a), and 1423) and section 6(c) of the Department of Transportation Act (49 U.S.C. 1655(c)))

NOTE: Since this document only extends the effectivity of a current regulation and does not impose a burden on the public or aviation industry, the FAA has determined that this document involves a regulation which is not a major rule under Executive Order 12291, is not a significant rule under Department of Transportation Regulatory Policies and Procedures (44 FR 11034; February 26, 1979), and does not warrant preparing a regulatory evaluation because the anticipated impact is minimal. For the same reason, I certify that this amendment will not have a significant economic impact on a substantial number of small entities under the criteria of the Regulatory Flexibility Act.

Special Federal Aviation Regulation 29

FAA Study of Limited IFR Operations in Rotorcraft

1. Contrary provisions of Parts 21, 27, and 29 of the Federal Aviation Regulations notwithstanding, an operator of a rotorcraft that is not otherwise certificated for IFR operations may conduct an approved limited IFR operation in the rotorcraft when—

(a) FAA approval for the operation has been issued under paragraph 2 of this SFAR;

(b) The operator complies with all conditions and limitations established by this SFAR and the approval; and

(c) A copy of the approval and this SFAR are set forth as a supplement to the Rotorcraft Flight Manual.

2. FAA approval for the operation of a rotorcraft in limited IFR operations may be issued when the following conditions are met:

(a) The operation is approved as part of the FAA study of limited rotorcraft IFR operations.

(b) Specific FAA approval has been obtained for the following:

(i) The rotorcraft (make, model, and serial number).

(ii) The flightcrew.

(iii) The procedures to be followed in the operation of the rotorcraft under IFR and the equipment that must be operable during such operations.

(c) The conditions and limitations necessary for the safe operation of the rotorcraft in limited IFR operations have been established, approved, and incorporated in the operating limitations section of the Rotorcraft Flight Manual.

3. An approval issued under paragraph 2 of this Special Federal Aviation Regulation and the change to the Rotorcraft Flight Manual specified in paragraph 2(c) of this Special Federal Aviation Regulation constitute a supplemental type certificate for each rotorcraft approved under paragraph 2 of this SFAR. The supplemental type certificate will remain in effect until the approval to operate issued under the Special Federal Aviation Regulation is surrendered, revoked, or otherwise terminated.

4. Notwithstanding § 91.23(a)(3) of the Federal Aviation Regulations, a person may operate a rotorcraft in a limited IFR operation approved under paragraph 2(a) of this Special Federal Aviation Regulation with enough fuel to fly, after reaching the alternate airport, for not less than 30 minutes, when that period of time has been approved.

5. Expiration.

(a) New applications for limited IFR rotorcraft operations under SFAR No. 29 may be submitted for approval until, but not including, the effective date of Amendment No. 1 of the Rotorcraft Regulatory Review Program. On and after the effective date of Amendment No. 1 of the Rotorcraft Regulatory Review Program, all applicants for certification of IFR rotorcraft operations must comply with the applicable provisions of the Federal Aviation Regulations.

(b) This Special Federal Aviation Regulation will terminate when all approvals issued under Special Federal Aviation Regulation No. 29 are surrendered, revoked, or otherwise terminated.

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UNITED STATES
GOVERNMENT PRINTING OFFICE
PUBLIC DOCUMENTS DEPARTMENT
Washington, D.C. 20402

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